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(BAW—10074A(Rev.1))
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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 43230, 43580

42151 **Coal technology '78. Volume 1.** Houston, TX; ICUC (1978). 493p. (CONF-781072—P1). ICUC, 6606 Bellaire Blvd., Suite 101, Houston, TX.

From Coal technology conference; Houston, TX, USA (17 Oct 1978).

The International Coal Utilization Convention was held October 17--19, 1978, at Houston, TX. Topics covered in Volume 1 included: the effects of the nature of the particular coal on boiler design, the feasibility of low or intermediate Btu gas used in combined-cycle power plants, the prospective market for low or intermediate Btu gas, the overall efficiency gains from combined-cycle power plants and co-generation (including optimization of the overall plant), coal preparation, industrial facilities burning coal, coal gasification, coal liquefaction, coal transport, storage and handling for small industrial users, and possible uses or waste disposal of fly ash and ashes. Twenty-five papers have been entered individually into the data base; two had been entered previously from other sources. (LTN)

PROCESSING

CARBONIZATION

REFER ALSO TO CITATION(S) 42223

42152 (FE—2782-9) **Formcoke Associates proposal review. Phase 2. Demonstration plant design review. R and D interim report No. 2.** (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Aug 1978. Contract EF-77-C-01-2782. 49p. Dep. NTIS, PC A03/MF A01.

The design and fixed capital investment estimate for a 3,000 TPD coke pellet demonstration plant presented in a proposal by Formcoke Associates has been reviewed. Based on the review of the data currently available from the ECPPP and the proposed demonstration plant design, we recommend that detailed design and construction of the demonstration plant be postponed until additional data and experience are obtained from the ECPPP. The additional data development needed prior to final design of the demonstration plant is described. The results of our review indicated that full process and engineering details were lacking in the proposal in many areas such as elemental balances, gas compositions, equipment specifications, gas cleanup systems, and utility requirements. This lack of information necessitated Parsons making a number of independent judgments and calculations to provide the basis for assessing the process design, required equipment specifications, and the fixed capital investment estimate. There is an incentive for development and introduction of a viable Formcoke technology in the U.S. These incentives include the potential for production of metallurgical-grade coke from a wide range of coals (including some noncaking coals), the potential for coke production in plants that will meet planned future environmental standards, the promise of lower cost production, and the potential advantages of continuous high-volume reliable production units.

42153 **Spetsial'nye vidy koksa. (Special forms of coke).** Makarov, G.N.; Filonenko, Yu.Ya. Moscow, USSR; Metallurgiya (1977). 168p.

The theoretical bases and practices for producing special forms of used for foundry purposes, agglomeration of iron ores, in electrothermal plants and as a smokeless fuel are described. The theoretical principles are given for producing special forms of coke, and an examination is made of the effect that the initial raw material and the conditions of its preparation and coking have on the quality of the final product. Substantiation is given for the technological requirements in the production of special forms of coke and the apparatus needed for its implementation. The book can be used by employees in the coke-chemical, agglomeration, foundry, and electrothermal sectors of industry, and by instructors and students at institutions of higher learning. 123 references, 49 figures, 95 tables.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 42195, 42225, 42295, 42832, 43232

42154 (EPRI-EM—1044) **Preliminary evaluation of chemical coal cleaning by promoted oxydesulfurization.** Beckberger, L.H.; Burk, E.H. Jr.; Grosboll, M.P.; Yoo, J.S. (Atlantic Richfield Co., Harvey, IL (USA)). Apr 1979. 128p. Dep. NTIS, PC A07/MF A01.

Atlantic Richfield Company has developed several proprietary process configurations for the chemical cleaning of coal. Two of the configurations incorporating promoted oxydesulfurization were selected for technical and economic evaluation. A One-Step Process utilizing relatively mild process conditions and a Two-Step Process including an additional higher severity reaction step were evaluated using a one-gallon batch reactor. Nearly all of the pyritic sulfur as well as up to 94% of the iron and 50% of the ash were removed by the One-Step Process. The Two-Step Process removed up to 35% of what is generally reported as organic sulfur. For both processes, 95% or more of the Btu value of the feed coal was recovered as product. A pilot plant employing a two-liter, continuous reaction system was constructed and operated. Initial results indicate sulfur removal efficiencies somewhat higher than predicted from first order reaction kinetics developed from the batch reactor data. Although engineering studies initially indicated an economic advantage for the reactor section, the cost of recovering the chemical reaction promoter more than off-set the reduced reactor section cost. Process alternatives incorporating both chemical and physical modifications to reduce costs are being evaluated.

42155 (PB—287091) **Assessment of coal cleaning technology: annual report (1st). Annual report Jan 77-Jan 78.** McCandless, L.C.; Shaver, R.B. (Versar, Inc., Springfield, VA (USA)). Jul 1978. Contract EPA-68-02-2199. 164p. NTIS PC A08/MF A01.

With a large projected increase in U.S. use of coal under the National Energy Plan, improved sulfur dioxide controls are quickly needed. Physical coal cleaning may prove to be the most cost-effective method for reducing sulfur dioxide emissions from small boilers, since many small industrial users will find flue gas desulfurization too costly. The report gives results to date of a continuing assessment of coal cleaning technology. It discusses: (1) washability characteristics of coal, with emphasis on the correlations of various washability parameters; (2) current technology on coal comminution and gravity separation processes; (3) eleven major chemical coal cleaning processes, including evaluations and comparisons; (4) current technology on mechanical and thermal drying and oil agglomeration; (5) slurry sampling techniques, including a summary of a Bias Test Plan for two slurry samplers; and (6) coal preparation requirements for synthetic fuel conversion processes, in terms of particle size, moisture, ash, sulfur, and heating value. In addition, coal preparation requirements for 6 high-Btu gasification processes, 13 low-Btu gasification processes, and 5 liquefaction processes are summarized.

HYDROGENATION

REFER ALSO TO CITATION(S) 43546

42156 Hydrogenation and hydrocracking with highly dispersed supported nickel catalysts. Yates, D.J.C.; Murrell, L.L. (to Exxon Research & Engineering Co.). US Patent 4,142,962. 6 Mar 1979. Filed date 13 Feb 1978. 12p.

GASIFICATION

REFER ALSO TO CITATION(S) 42225, 42226, 42230, 42232, 42233, 42237, 42253, 42496, 42508, 43231, 43401

42157 (ANL/CES/TE—79-1) **Low- and medium-Btu coal gasification processes.** Baker, N.R.; Blazek, C.F.; Tison, R.R. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1979. Contract W-31-109-ENG-38. 69p. Dep. NTIS, PC A04/MF A01.

Coal gasifiers, for the production of low- and medium-Btu fuel gases, come in a wide variety of designs and capacities. For single gasifier vessels gas energy production rates range from about 1 to 18 billion Btu/day. The key characteristics of gasifiers that would be of importance for their application as an energy source in Integrated Community Energy Systems (ICES) are evaluated here. The types of gasifiers considered here are single- and two-stage, fixed-bed units; fluidized-bed units; and entrained-bed units, as producers of both low-Btu (less than 200 Btu/SCF and medium-Btu (200 to 400 Btu/SCF) gases. The gasifiers are discussed with respect to maximum and minimum capacity, the effect of feed coal parameters, product characteristics, thermal efficiency, environmental effects, operating and maintenance requirements, reliability, and cost. Some of the most recent development work in this area of coal conversion, and use of these gas products also is considered. Except in small plant installations ($< 10^9$ Btu/day) the annual operating costs for the various gasifier types are approximately the same. This is somewhat surprising in view of the personnel requirements, efficiencies, utility requirements, heating value of the product gas, and operating characteristics associated with each. Operating costs tend to increase with a power function exponent of 0.92 (i.e., a doubling in plant capacity increases the operating cost by about 1.9).

42158 (COO—4589-1) **Thermodynamic-economic analysis of the synthane process.** Gaggioli, R.; Rodriguez, L.; Wepfer, W. (Marquette Univ., Milwaukee, WI (USA)). Nov 1978. Contract EY-77-S-02-4589. 104p. Dep. NTIS, PC A06/MF A01.

This report presents an exhaustive Second-Law analysis of the SYNTHANE process, including an efficiency and a costing study, both based on the available energy concept. The analysis shows an overall process efficiency of 46%. For 100 kwhr of useful energy supplied with coal, 51 kwhr are consumed driving the various unit operations while effluents carry 3 kwhr. Unit 30, Steam and Power Production, consumes nearly 20 kwhr; Unit 15, Gasification, uses up nearly 16 kwhr. Units 12 and 14, Coal Preparation and Feeding, about 5 kwhr; Units 16 and 17, Raw Gas Quench and Shift Conversion, 4 kwhr; Unit 32, Oxygen Plant, ~ 2 kwhr; Miscellaneous units, 4 kwhr. The costing study shows that the largest increases in cost of useful energy (say in cents/kwhr) occur across Unit 15 and especially Unit 30; there are significant rises across Units 12 and 14, and Unit 18 (Acid Gas Removal). The conceptual design of Unit 30 (and 32) clearly leads to inordinately high costs for utilities (steam, power, oxygen), compared to common utility costs readily attainable even with more expensive fuels. A preliminary recosting, assuming reasonable (yet conservatively high) costs of utility production, showed that product gas cost would be reduced from 2.1 cents/kwhr to 1.7cents/kwhr, readily. Thus, the Second Law analysis pinpoints the inefficiencies and the opportunities for improvement of the SYNTHANE process.

42159 (FE—1548-17) **Experimental and process design study of a high rate gasification process. Quarterly technical report No. 17, April—June 1978.** McIntosh, M.J. (Eyring Research Inst., Provo, UT (USA)). 1978. Contract EX-76-C-01-1548. 31p. Dep. NTIS, PC A03/MF A01.

A total of 273 test runs have been made to date for a total of 802 operating hours. Extensive equipment modifications have been made to overcome problems with non-uniform coal feeding, feed injector plugging, refractory overheating, heat recovery section plugging and scrubber discharge plugging. Over 20 different feed injector and reaction chamber configurations have been tested. The highest conversion efficiency was achieved with single stage coal injection through either two or three feed nozzles, the oxygen and steam being fed through a single swirled nozzle. A semi-empirical mathematical model has been developed which correlates the data very well and simultaneously calculates an Arrhenius type activation energy for the gasification of carbon. The activation energy is taken as a measure of coal reactivity, a high value corresponding to a less reactive coal. In order to obtain data sufficiently precise to allow model fitting, it has been necessary to more carefully calibrate the steam and oxygen feed meters, weight coal in and out instead of relying on the coal feed meter, and take extensive data on the effect of oxygen feed rate at a set steam feed rate without shutting down the gasifier between the various levels of oxygen feed rate. A critical review was made of prior work with entrained flow gasifiers. This was followed by a preliminary design study of a commercial scale gasifier having a throughput capacity of 25 tons per hour.

42160 (FE—1775-19) **Prestressed concrete pressure vessels: conceptual design/economic analysis. Executive summary. R and D report No. 114, interim report No. 8.** (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Sep 1978. Contract EX-76-C-01-1775. 44p. Dep. NTIS, PC A03/MF A01.

This report summarizes the results of a study which determined that the use of prestressed concrete pressure vessels (PCPV's) in coal conversion plants is technically feasible and offers potential economic advantages. Four representative types of PCPV's were studied. Depending on the type of PCPV, it was found that reductions in fixed capital investment as high as 70%, amounting to as much as $300 million, are possible by the substitution of large PCPV's for steel vessels; the PCPV's would use state-of-the art technology and proven construction methods and equipment. Continued development of prestressed concrete pressure vessels is recommended.

42161 (FE—1775-20) **Prestressed concrete pressure vessels conceptual design/economic analysis. R and D report No. 114, interim report No. 8.** O'Hara, J.B.; Howell, R.D.; Lee, J.C.; Lin, T.Y.; Chow, P.C.; Ngo, D. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Oct 1978. Contract EX-76-C-01-1775. 173p. Dep. NTIS, PC A04/MF A01.

The results of the study indicate: The design and construction of prestressed concrete pressure vessels (PCPVs) was found to be generally within the present state of knowledge. Subscale testing should be performed to confirm some design judgements. The use of PCPVs can reduce the FCI requirements. To illustrate, substitution of a single PCPV for as many as 18 steel vessels might reduce the FCI by approximately 70 percent, amounting to as much as $300 million. Replacement of a single steel vessel with a PCPV can reduce the FCI by approximately 10 percent. Thus, there is a definite economic incentive to carry further the development of PCPVs to demonstrate their technical feasibility and economic viability. PCPVs offer an alternative for construction of large scale coal conversion plants. Improved vessel safety performance is expected because of the benign failure characteristics of PCPVs. PCPVs have the potential to be operational in a shorter schedule than steel vessels. At the time of this writing, supply projections indicate that the materials of construction for PCPVs can be readily available in the U.S. while the capacity to fabricate and install large numbers of large heavy walled steel pressure vessels was found to be currently limited by the number of suppliers and availability of fabrication facilities. A three-part program designed to further develop PCPVs for still higher pressure operations has been developed.

42162 (FE—1793-34) **Coal Feeder Development Phase II. Quarterly report, 1 July 1977—30 September 1977.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jan 1978. Contract EX-76-C-01-1793. 26p. Dep. NTIS, PC A03/MF A01.

Program effort was directed toward completion of all testing on the Foster—Miller centrifugal and fluidized piston feeder prototypes and assembly and checkout of the linear pocket feeder prototype. The centrifugal feeder has met or exceeded all Phase II performance goals. The technical feasibility of this concept has been established. It is recommended that Phase III effort on the centrifugal feeder concept be initiated. The prototype piston feeder has not achieved Phase II performance goals. Coal feed rate has ranged from 250 pounds per hour at 600 psi to 100 pounds per hour at 900 psi. Additional development of the prototype feeder is required to achieve specified goals. Further Phase II level development of the prototype feeder is recommended with emphasis on improving valve performance. Limited testing of the linear pocket feeder prototype has revealed no significant problems to date.

42163 (FE—2240-96) **Fixed bed methanation processes. Final report.** Sirohi, V.P. (Braun (C.F.) and Co., Alhambra, CA (USA)). Aug 1978. Contract EX-76-C-01-2240. 36p. Dep. NTIS, PC A03/MF A01.

Based on the economic comparison of this study, it has been concluded that the process arrangement of Hot Gas Recycle is economically attractive because it allows a maximum steam production at high pressure. The use of a high temperature catalyst results in a more economical process design in comparison with a low temperature catalyst. This is due to the increase in temperature rise across the methanator reactors, which in turn reduces the recycle flow rate, catalyst requirements, and vessel sizes. More efficient heat recovery is also obtained. It is also concluded that the three reactor system is more economical than a single reactor methanation process. The use of the Hot Gas Recycle with three reactors is recommended for all types of methanation catalysts. A high temperature catalyst has a further economic advantage over other catalysts. It is

recommended that such a catalyst be demonstrated commercially to confirm its potential.

42164 (FE—2286-36) **Preparation of a coal conversion systems technical data book. Quarterly report, May 1—July 31, 1978.** (Institute of Gas Technology, Chicago, IL (USA)). Feb 1979. Contract EX-76-C-01-2286. 244p. Dep. NTIS, PC A11/MF A01.

In this report, we have described a number of correlations for estimating slag viscosity as a function of composition and temperature. Properties of cis- and trans-decalins and six xylenols are tabulated in both the SI and British units. Graphs of physical properties of all the compounds received so far from Thermodynamic Research Center, Texas A & M University, are presented. Results of evaluation of our calorific value formula by three laboratories are reported. We have discussed vertical, dense-phase, gas-solids transport. Published correlations for pressure drop in the packed flow regime are discussed. We compared the heat transfer coefficients, calculated using various correlations, with the experimental values from the slurry preheater of the SRC pilot plant at Wilsonville and from SRC-I mode of operation of the pilot plant at Tacoma, WA. Comparative aqueous corrosion data on various metals and alloys are reported. Comparison of pilot plant corrosion data is made with that obtained in the laboratory.

42165 (FE—2356-88) **Valve development for coal gasification plants. Phase II. Monthly/quarterly technical program report, January—March 1979.** Bellezza, D. (Fairchild Industries, Inc., Manhattan Beach, CA (USA). Fairchild Stratos Div.). Apr 1979. Contract EX-76-C-01-2356. 17p. Dep. NTIS, PC A02/MF A01.

The eleventh in a series of Quarterly Technical Progress Reports relating to the Valve Development for Coal Gasification Plants Program discusses engineering progress during the period of January to March 1979.

42166 (FE—2542-13) **Phase I: the pipeline gas demonstration plant. Technical support program report.** Aul, E.F.; Curran, G.P.; Fink, C.E.; Heunisch, G.W.; Spangler, M.D.; Sudbury, J.D. (Continental Oil Co., Stamford, CT (USA)). 1978. Contract EF-77-C-01-2542. 446p. Dep. NTIS, PC A19/MF A01.

Contract No. EF-77-C-01-2542 between Continental Oil Company and the U.S. Department of Energy requires Continental Oil to design, construct, and operate a demonstration plant capable of converting bituminous caking coals into pipeline quality gas. One of the assignments under the contract is to obtain the requisite data base for the process and engineering design of the demonstration plant. The British Gas/Lurgi slagging gasifier was the process selected by the contractor to convert the coal to a crude synthesis gas which can be processes to yield pipeline quality gas. This gasifier had been primarily developed, prior to the contract execution date, for processing non-caking bituminous and subbituminous coals, but the data base was insufficient for designing the gasifier and associated upstream and downstream processing units for processing the coals selected for the demonstration plant. A technical support program to provide the requisite data base was implemented at the Westfield Development Centre of British Gas Corporation. This facility was selected because a large slagging gasifier pilot plant is located there. The technical support program has been completed, and the data and information required by British Gas Corporation and Lurgi Kohle und Mineraloeltechnik to design the gasifier and the gasification section of the demonstration plant were obtained. The program also provided the data and other information needed to design the associated upstream and downstream processing units. The technical support program verified that the British Gas/Lurgi slagging gasifier can satisfactorily process bituminous caking coals, and considerable start-up and operating experience on such coals was obtained in carrying out the program.

42167 (FE—2542-14) **Phase 1: the pipeline gas demonstration plant. Quarterly technical progress report, July 1—September 30, 1978.** Sweany, G.A. (comp.). (Continental Oil Co., Stamford, CT (USA)). 1978. Contract EF-77-C-01-2542. 81p. Dep. NTIS, PC A05/MF A01.

On July 21, 1978, DOE announced that the Government would conduct a formal, competitive evaluation of Continental Oil Company's project and the Illinois Coal Gasification Group's project. The evaluation process would be completed in October and it is likely that one of the projects would be terminated for the convenience of the Government. All required data, information, and position statements from Continental Oil Company were submitted within the required deadlines. The Design and Evaluation of a Commercial Plant was completed and reported to DOE. Continental Oil Company's Engineering Center has studied and reported four additional technical alternatives to the original design. These alternatives could reduce the cost of gas by $1.40 to $1.70 per million Btu with a moderate increase in the risk of technical failure. The environmental analysis program was continued at the slowdown rate established in January. The proprietary process license agreements for Phosam W Process and the SCOT process have been submitted to DOE for approval. A secrecy agreement for the Amoco Claus process has been submitted for comments before concluding a license agreement with Foster Wheeler Energy Corporation. The original Westfield Agreement was terminated on March 31, 1978, and a 2 1/2 month continuation was formulated under the Westfield II Agreement.

42168 (FE—2577-T2) **Synthesis gas demonstration plant program. Quarterly technical progress report, 1 July—30 September 1978.** Simpson, M.R. (Grace (W.R.) and Co., Memphis, TN (USA)). 1978. Contract EF-77-C-01-2577. 20p. Dep. NTIS, PC A02/MF A01.

The majority of the technical work effort was directed toward finalization of design parameters. This was accomplished through continuing efforts on the various Trade-Off Studies (TOS) and incorporation of resulting recommendations into the Commercial Plant design. The final TOS IV report - Air Quality Control System Alternatives was issued. Also drafts of reports for TOS II - Gas Purification Alternatives and TOS V - Cooling Tower Optimization were prepared and are being reviewed prior to revision and issue. Based on data thus developed, the preparation of design documentation in the form of process schematics, equipment lists and process duty specification sheets has progressed. Activities in the environmental and site confirmation areas have continued. Drafts of the Site Confirmation Report and two chapters of the Environmental Report were received. On site activities in support of the environmental effort are continuing and direction was given to proceed with an Air Quality Monitoring Program. Other activities included completion of the Design Coal Investigation, initiation of work efforts on the part of Texaco Development Corporation's Houston engineering group and continuing incorporation of revisions to the Design Concept for the Demonstration Plant and the Plan for Obtaining Approval, Permits and Licenses from Agencies.

42169 (FE—3031-2) **Design and simulation of a recirculating bed reactor for coal hydrogasification. Quarterly report, 1 October—31 December 1978.** Bierl, T.W. (Carnegie-Mellon Inst. of Research, Pittsburgh, PA (USA)). Feb 1979. Contract ET-78-S-01-3031. 91p. Dep. NTIS, PC A05/MF A01.

This report reviews progress for the second quarter of the contract. An LP model was constructed to aid in establishing the base case product strategy; the background needed to design the recirculating bed reactor components was developed; a review of ancillary process unit operations was completed; and the logic and structure of the (non-linear) process simulator was defined, coded, and debugged.

42170 (LA—7776-PR) **Combined CO_2—O_2 underground pyrolysis-gasification of southwestern coals. Progress report, January—March 1978.** Vanderborgh, N.E.; Elliott, G.R.B. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Studies in the underground coal conversion project centered around the modification of mass transfer parameters that occur during thermal processing of subbituminous coals. Such modifications influence heat transfer paths and can significantly alter heat transfer mechanisms. Laboratory studies are reported that show that these coals shrink by approximately 10% of original volume when heated, causing regions of greatly enhance connected porosity. Experiments are also reported that measure the rates of heat transfer in dry, porous blocks driven by known convective gas flux into samples of precise geometry. Permeability measurements are also presented that describe mass transfer through controlled porous samples.

42171 (MERC/SP—78/4) **Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.** (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Research Center; Valve Manufacturers Association, McLean, VA (USA)). 1978. Contract EY-77-C-21-2936. 464p. Dep. NTIS, PC A20/MF A01.

The workshop on valves for solids handling service in coal conversion was held at Morgantown, WV, November 14—16, 1977. It was co-sponsored by the United States Department of Energy, Morgantown Energy Research Center and the Valve Manufacturers Association with the assistance of TRW Energy Systems Group and West Virginia University. Sixteen papers have been entered individually into EDB and ERA. (LTN)

42172 (MERC/SP—78/4, pp 15-29) **Overview of planned energy demonstration and commercialization activities.** Jones, H.T. (Dept. of Energy, Washington, DC). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

DOE activities in coal conversion and utilization are described briefly. Many of the early proven development units and pilot plants have had equipment and valve problems. The DOE has programs involving more than $12 million to develop, evaluate and

test valves for lockhopper applications. Generally, valves, in coal conversion plants are exposed to a very hostile environment due to the temperature, pressures, and particulates. But, for economic reasons, they must operate reliably, with a minimum leakage, for a reasonable long and predictable operating life. (LTN)

42173 (MERC/SP—78/4, pp 30-58) **Operating experience with solids handling valves in the HYGAS pilot plant program.** Hudziak, J.; Kendron, T.J.; Bair, W.G. (Institute of Gas Technology, Chicago, IL). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

Operation of the HYGAS pilot plant has resulted in the evolution of several successful applications of solids handling valves. This experience will be most useful in the design of demonstration and commercial plants based on the HYGAS technology or other applications of solids handling in coal conversion processes.

42174 (MERC/SP—78/4, pp 59-76) **Valve problems at the CO_2 Acceptor Pilot Plant, Rapid City, South Dakota.** Vardaman, M.H. (Stearns-Roger, Inc., Rapid City, SD). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

Valve problems can be grouped into two categories. They are: (1) Areas of cyclic operation such as pressurizing and depressuring of lockhoppers, sample containers, etc. (2) The areas of continuous control, such as pressure control, flow control and level control. The areas are described in detail with diagrams showing the conditions that the valve was subjected to.

42175 (MERC/SP—78/4, pp 77-97) **Valve experiences in the SYNTHANE Pilot Plant.** Dubis, D.; Santore, R.R.; Lewis, R. (Dept. of Energy, Pittsburgh, PA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

After more than one year of operation and a throughput of 2500 tons of dried coal, there have been no major problems with solids handling valves which operate at zero differential pressure and are regularly purged. Initially, there were problems with other ball valves due solely to mechanical difficulties. These problems have been solved and for the past six months the operation of these valves has been satisfactory. Valves which handle streams containing significant amounts of solids ($> 3\%$) and which are in a pressure letdown service ($\Delta P > 10$ psi) have been extremely susceptible to erosion. Service life has been extended, in some cases appreciably, by changing valve configuration and materials of construction.

42176 (MERC/SP—78/4, pp 98-121) **Valve applications at the SYNTHANE Plant in mixed phase erosive service.** Bailey, D.M.; Massa, A.W.; Runnels, O.D.; Strebinger, P.C. (C-E Lummus, Bruceton, PA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

Three different control valves used for depressuring abrasive, high-pressure, process streams containing coal fines have been improved by upgrading their trim materials. Original trims were of ceramic or of stainless steel coated with stellite; upgraded trims are tungsten carbide. The new materials have significantly improved valve life. These valves are in operation at the SYNTHANE Pilot Plant, a high BTU coal gasification facility operated for the Department of Energy by The Lummus Company. The Plant has been in operation since July of 1976. To date more 2000 tons of coal have been gasified and these valves have been subjected to nearly 1000 hours of operation.

42177 (MERC/SP—78/4, pp 122-132) **Review of material development activities in support of valve design improvements.** Kelley, J.E. (Bureau of Mines, Albany, OR). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

Laboratories participating in DOE or EPRI sponsored contracts for valve-related research are identified and their research programs described briefly. (LTN)

42178 (MERC/SP—78/4, pp 133-149) **Department of Energy prototype valve development program status.** Jukoff, D. (Consolidated Controls Corp., El Segundo, CA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

The thermal analysis of the spring chamber in the Consolidated Controls Corporation Valve design indicated temperatures as high as 1700°F could be reached. This dictated use of a spring made of ceramic. The seats in this design are ceramic with flat lapped faces. Ceramic can be finished sufficiently fine to create a jo-block effect when the seat and gate disc are wiped together. This permits exceptionally low interface leakage as we have demonstrated in our 8-inch valve element testing where seat-to-disc leakage at 1600 psig differential pressure was of the order of 0.050 scfm nitrogen gas. Again, the superior qualities of ceramic to resist wear, corrosion, and because of its hardness remain unaffected by contamination, gives it a high rating as a candidate for seat material.

42179 (MERC/SP—78/4, pp 150-195) **Department of Energy prototype valve development program status.** Corkery, R. (Fairchild Stratos Div., Manhattan Beach, CA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

This program has been established to develop four types of lock hopper valves suitable for use at high pressure, and with the elevated temperature bulk materials associated with coal gasification processes. Phase I includes the requirements definition, layout of valves, analysis, component fabrication and testing. Under phase I testing is a major effort to establish the final configuration of the valve.

42180 (MERC/SP—78/4, pp 196-202) **Lock hopper valves for coal gasification plant service.** Schoeneweis, E.F. (Rockwell International, Pittsburgh, PA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

The design, construction and testing of lock hopper valves is described. (LTN)

42181 (MERC/SP—78/4, pp 203-222) **Solids handling valves in lockhopper service at the Morgantown Energy Research Center, experience and problems to testing and development.** Gardner, J.F. (Morgantown Energy Research Center, WV). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

In the state-of-the-art SOA Program, valves from 15 different manufacturers have been placed on order or delivered to MERC. These valves were selected based on the Morgantown Energy Research Center Survey of Industry for Valves for Coal Conversion Processes conducted during December 1976 to February 1977. The Morgantown Survey contacted over 100 valve manufacturers and representatives with specific lockhopper valve performance requirements asking for the valve industry's capability to furnish currently available off-the-shelf valve hardware, or rapidly implemented modifications of currently available hardware. The survey report is currently being revised and will be published. The second testing program at MERC is the Prototype Valve Testing and Development Program. This program has as its primary objective to: evaluate the prototype valve designs under simulated service conditions; provide data for design changes to improve valve reliability and reduce maintenance costs; compare the prototype valve designs performance with existing off-the-shelf valve designs; and provide verification of design modifications.

42182 (MERC/SP—78/4, pp 223-246) **Report of survey of valve industry capabilities.** Bush, W.A.; Slade, E.C. (Oak Ridge National Lab., TN). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

To evaluate the valve requirements associated with coal conversion, seven prospective coal conversion design concepts were studied; flow streams were determined; valve types were assigned and the valves were sized. At present, it appears that the coal conversion processes operate in the range of the present petrochemical industry, except for that portion of the process where the coal is converted to gas and oil. The analysis resulted in the identification of twenty-four high temperature valve applications that appeared more stringent than the petrochemical industry needs. To determine the industry capability to supply valves for these applications, questionnaires were mailed to two hundred and thirty-one valve manufacturers. Although the results of the survey show that the valve industry is capable of manufacturing, in quantity, equipment of the size and for the pressure and temperature range which would be required in the coal conversion industry; valve manufacturers do not have product application experience to predict the continuing functional ability of valves used for lock hopper feeders, slurry feeders and for slag/char let-down service. Developmental and testing efforts to modify existing valve design or develop new valve concepts for these applications were estimated to range from one to six years. A testing facility to simulate actuation of critical valves under service conditions would be beneficial.

42183 (MERC/SP—78/4, pp 247-261) **Determination of parameters and design suggestions for valves in critical locations of fossil energy conversion plants.** Slade, E.C. (Oak Ridge National Lab., TN). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

To summarize, it would appear that an analysis of the complexities of multi-phase slurry and gas flows is appropriate with perhaps the derivation of new or better application of old formulas resulting. This would allow for the specialization of design of valves

and the inclusion of new materials. Consequently, new designs could be implemented that would provide a history of operation and the opportunity for further development.

42184 (MERC/SP—78/4, pp 262-274) **Temperature profiling of valves in coal-conversion systems by infrared thermal imaging.** Shack, W.J.; Ellingson, W.A. (Argonne National Lab., IL). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

One of the requirements in the development of valves for coal-conversion systems is a test program to verify that the valves can operate satisfactorily at high temperatures. The operating conditions in the test program should simulate the actual thermal gradients, thermal stresses, and internal temperatures expected in service. Thus, realistic testing requires a knowledge of thermal profiles from valves in actual service. To acquire these profiles, infrared thermal scans were performed on several valves at the Morgantown Energy Research Center (MERC) Low-Btu Gasification Facility. A portable infrared camera system was used, and full-field thermal images of the valves during normal operation were obtained. The valves examined at MERC were the top cyclone lockhopper valve, the top ash lockhopper valve, and the north bottom coal lockhopper feed valve. The thermal profiles obtained for the three valves are similar in character. The surface temperatures were surprisingly low, and no significant thermal gradients were observed.

42185 (MERC/SP—78/4, pp 275-302) **Detection of valve leakage by acoustic-emission techniques.** Shack, W.J.; Ellingson, W.A. (Argonne National Lab., IL). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

Acoustic-emission studies leading to the development of an on-line noninvasive leak-detection system for valves in coal-conversion plants are reported. The system is based on the detection and characterization of acoustic emissions generated in the valve body by turbulent flow through a leakage channel. The program is oriented toward a qualitative leak-detection system for the large (4 to 10 in.) valves used in lockhopper feed and letdown systems; however, some studies related to the quantitative measurement of flows through simple orifices will also be discussed. Field measurements at the Synthane and Morgantown Energy Research Center pilot plants indicate the existence of relatively high levels of structure-borne background noise at frequencies <500 kHz in operating plants. This suggests that an on-line acoustic detection system should operate at frequencies above 500 kHz. Both laboratory and field studies show that the amplitude of the frequency spectrum of the acoustic emissions generated by leakage flows decreases quite sharply above 175 kHz. However, recent tests on full-size valves at the MERC test facility show that a 750-kHztransducer can detect leakage at levels below those (1-cfm/in. diameter) considered acceptable by Morgantown Energy Research Center. Thus, development of a system with high immunity to background noise and adequate sensitivity appears attainable.

42186 (MIT—2295T9-9) **Computer-aided industrial process design: the ASPEN project. Second annual report, June 1, 1977—May 30, 1978.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Jun 1978. Contract EX-76-C-01-2295-009. 276p. Dep. NTIS, PC A13/MF A01.

The objective of this project is to develop a computer-based process simulator and economic evaluation system for use in thengineering of fossil energy conversion processes. The system has been named ASPEN (Advanced System for Process Engineering). It will provide the US Department of Energy (DOE) and its contractors with a rapid, efficient, and consistent means of performing its process evaluation functions. ASPEN will be capable of performing detailed material and energy balances, equipment sizing, and economic evaluation for processes such as coal gasification and liquefaction. It will be designed to meet the specialized requirements of fossil energy conversion processes, including an extensive data base for coal physical properties, compatibility with conversion reactor models currently available and/or being constructed, and the capability of handling steams containing solids.

42187 (SAND—79-1021C) **Instrumentation and analysis techniques for future UCG applications.** Hommert, P.J.; Davidson, G.S. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-790630—6). Dep. NTIS, PC A02/MF A01.

From 5. underground coal conversion symposium; Alexandria, VA, USA (18 Jun 1979).

Over the past five years Sandia Laboratories has been engaged in instrumentation development for the In Situ Coal Gasification Program. This paper summarizes the present state of this work with particular emphasis on future instrumentation systems. While continued improvements in hardware are being pursued, considerable work over the past year has been in the development of standardized analysis software. Procedures developed to produce a real-time display of the affected coal region are discussed. Two key elements of the software are generality, i.e., application independent of test site or well pattern, and implementation on a field minicomputer. The requirements for the use of this software in terms of instrumentation hardware and data acquisition are outlined. The accuracy of results is examined through the use of generated data. Results indicate that on future tests, with increased confidence in model predictions and greater reliance on remote monitoring techniques, the same information can be obtained with significantly fewer instrumentation wells.

42188 (TSR—79/3) **Coal pump development and technical support project. Quarterly report, 1 January—1 April 1979.** Phen, R.; Mattson, L.; Schatz, W. (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EF-77-A-01-2616. 36p. Dep. NTIS, PC A03/MF A01.

Longer test runs at higher delivery pressures are continuing with the IMPCO 1500 screw feeder of Ingersoll Rand. Steady state coal delivery with 10% pitch was maintained for 1.5 hours at 750 psi pessure. The piston feeder has been installed on the batch loop and test system; debugging is in progress. LMSC's model No. 3 Kinetic Extruder was installed in the horizontal housing and test system hookup and instrumentation will be complete mid-April. Coal testing will follow with pressure delivery tests to the previously achieved 400 psi pressure load. Foster Miller's Linear Pocket Feeder was installed on the 5 tph batch loop and short duration checkout testing was conducted with coarse (1 inch x 0) coal at atmospheric and 500 psi pressures. Six tests were conducted at JPL using the Egan 2.5-in., single-screw extruder and one test was conducted at Wernier and Pfleiderer Inc., using a twin-screw extruder. The tests were generally characterized by improved control and more stable operation, permitting examination of specific effects under better conditions. Testing on the Centerline Machinery 1.5-in. coal pump was completed February 9. Before the shutdown, runs were made on the shallow channel screws and Lower Freeport coal was extruded. Set up of the Davis Standard 1.5-in. extruder was completed and initial tests made.

42189 (UCRL—82428) **LLL 1979 field program.** Hill, R.W.; Stephens, D.R.; Thompson, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1979. Contract W-7405-ENG-48. 25p. (CONF-790630—4). Dep. NTIS, PC A02/MF A01.

From 5. underground coal conversion symposium; Alexandria, VA, USA (18 Jun 1979).

The major effort this year is the planning and construction of our next field experiment, Hoe Creek No. 3. This is to be a full steam/oxygen test using a directionally drilled linking channel to be ignited later this summer. The directionally drilled hole, DD-1 has been completed as well as most of the rest of the well patterna and surface plant. A description of the current status and of our plans for the rest of the year will be given.

42190 (UCRL—82602) **Laboratory coal gasifier facility.** Aiman, W.R.; Thorsness, C.B.; Cena, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Apr 1979. Contract W-7405-ENG-48. 35p. (CONF-790434—3). Dep. NTIS, PC A03/MF A01.

From Spring meeting on western states section, and the Combustion Institute; Provo, UT, USA (23 Apr 1979).

The In Situ Coal Gasification Project at the Lawrence Livermore Laboratory has developed a laboratory coal gasifier test facility. The facility consists of systems for metering gases into an experimental gasifier, condensing the tar and water out of the product gases and flaring them, sampling and analyzing the product gases, and monitoring the gasifier during an experiment. The major items of equipment include: a CVC mass spectrometer, a Hewlett—Packard process gas chromatograph, a Hewlett—Packard 21 MX-E mini-computer, and the experimental coal gasifiers-currently a 1.5 m fixed-bed gasifier and a 0.9 m bore-hole gasifier. This facility is described and the use of the facility in validating software and hardware for use in field experiments are discussed. The results of an experiment with the 1.5 m fixed-bed gasifier are described. Temperature profiles down the centerline of the reactor at various times during the experiment are discussed. Product gas compositions are discussed.

42191 **Predictions on the disposition of select trace constituents in coal gasification processes.** Anderson, G.L.; Hill, A.H.; Fleming, D.K. Chicago, IL; Institute of Gas Technology (1979). 43p. (CONF-790449—2).

From EPA fuel conversion symposium; Hollywood, FL, USA (17 Apr 1979).

Many factors may affect the formation and disposition of minor and trace constituents in coal gasification processes - e.g., the coal feedstock, the gasification conditions, and the gas processing conditions. Adequate knowledge of the forms and amounts of these constituents and the controlling factors which dictate their final disposition would be desirable for a complete design of a full scale plant. However, the current data base for some of the more volatile inorganic trace constituents which may be formed during the gasifi-

cation of coal is weak. In this paper, theoretical projections are made on the amount and final disposition during coal gasification of volatile trace compounds formed from arsenic, boron, lead, selenium, and mercury present in coals. Note that these predictions are theoretical; they are intended to provide insight into what might occur in coal gasification processes, to provide direction for future experimental work for improving the data base on these constituents, and to indicate areas where further investigations would prove useful for the design of full scale processes. The results of these studies indicate that high recoveries of these trace inorganics with low discharge to the environment are to be expected in most coal gasification process designs.

42192 Use of high-frequency electromagnetic waves for mapping an in situ coal gasification burn front. Davis, D.T.; Lytle, R.J.; Laine, E.F. (Univ. of California, Livermore). Contract W-7405-ENG-48. *In Situ;* 3: No. 2, 95-119(1979).

High-frequency electromagnetic waves transmitted between boreholes can be used to map the position of an underground coal gasification (UCG) burn front, as well as other geophysical anomalies. The technique uses transmitting and receiving antennas lowered down boreholes on either side of the gasified region. Results from the use of this technique in a UCG experiment show high resolution and close agreement with data from thermocouples. The depth and height of the burn front were easily determined and subsidence of overburden was also evident in the measurements. Several variations on the method were tried. This technique promises several advantages over other down-hole instrumentation: lower cost, better spatial coverage, and the ability to give measurements both during and after passage of the burn front. The UCG experiment also showed several improvements that could be made in the technique.

42193 Relative erosion resistance of selected materials. *Mater. Compon. Newsl.;* No. 19, 2-4(1 Dec 1978).

With the exception of tungsten and molybdenum, metallic base materials have relatively low erosion resistances for severe erosion situations. Therefore, if a metallic component has failed prematurely by erosion, no significantly better behavior can be expected from a metallic substitution, regardless of hardness. Fortunately, several ceramics, cermets, and ceramic coatings have greatly improved erosion resistances. These include WC, SiC, Si_3N_4, B_4C, CBN, ZrB_2, electrodeposited TiB_2, and boronized WC, molybdenum, and tungsten. Ceramics are most resistant when manufactured by a method that will insure optimum density. With cermets, a minimum amount of metallic binder is desirable and with coatings, a sufficient coating-substrate compatibility and coating thickness are essential.

LIQUEFACTION

REFER ALSO TO CITATION(S) 42160, 42164, 42171, 42172, 42177, 42182, 42183, 42186, 42212, 42214, 42216, 42218, 42230, 42232, 42253, 42266, 42514

42194 (EPRI-AF—913) **Investigation of mechanism of reactions involving oxygen-containing compounds in coal hydrogenation. Final report.** Cronauer, D.C.; Ruberto, R.G. (Gulf Research and Development Co., Chestwick, PA (USA)). Mar 1979. 245p. Dep. NTIS, PC A11/MF A01.

The objective of this project was two-fold, namely, to develop an understanding of reactions involving oxygen during hydrogenative liquefaction and to establish a kinetic model to describe coal liquefaction. Emphasis was directed toward the liquefaction of Belle Ayr subbituminous coal with subsequent test runs made with Burning Star bituminous coal. The liquefaction experiments were made in a CFSTR bench-scale unit operated at temperatures between 400 and 470°C, space timees between 5 and 60 minutes and a fixed total pressure of 2000 psig. It was shown that between 70% and 85% of the coal organic oxygen is removed as carbon oxides and water. Carboxylic, carbonylic, and etheric functionalities of coal are essentially removed during the liquefaction reaction. The most abundant oxygen-containing group in the reaction product is hydroxylic, a portion of which is necessarily formed by a reduction of other groups. The results of liquefying Belle Ayr coal were correlated by a kinetic model. It is shown that this reaction mechanism (with all reaction rates assumed to be pseudo first order with respect to reacting species) correlates data reasonably well at the temperature levels of 400°C, 425°C, and 450°C for all space times, and at 460°C and 470°C for small space times. The donor capacity of the solvent strongly affects the rates of the various reactions. This model does not correlate the data for the liquefaction of Burning Star coal in that negative oil yields are observed at short space times. These negative yields are due to solvent entrapment and/or reaction of the solvent with heavy coal liquefactions products.

42195 (FE—0496-157) **Solvent refined coal (SRC) process. Quarterly technical progress report, April 1, 1978—June 30, 1978.** (Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS (USA)). May 1979. Contract EX-76-C-01-0496. 161p. Dep. NTIS, PC A08/MF A01.

This report summarizes the progress of the Solvent Refined Coal (SRC) project by The Pittsburg & Midway Coal Mining Co. for the Department of Energy for the period April 1, 1978 through June 30, 1978. Major activities at the pilot plant included a scheduled plant turnaround and the blending of 4,500 barrels of SRC II fuel oil for use in a large-scale combustion test. During the turnaround major efforts were directed towards tie-ins and modifications necessary for the startup of Filter C and an extensive examination of process piping, heat exchangers, and vessels. Construction of the Lummus anti-solvent deashing unit continued during the quarter. Activity at the Merriam Laboratory included a study of the process factors in SRC II that lead to increased oil yields relative to SRC I operation and exploratory short residence time SRC I operation. An upgraded and modernized continuous bench scale unit was started up to replace the existing bench scale unit. The one-ton-per-day P-99 process development unit at Gulf's Harmarville facilities became part of the SRC program April 1. It ran SRC II experiments with Pittsburgh seam coals during the quarter.

42196 (FE—1517-66) **Coal liquefaction test center. Annual technical progress report, January 1—December 31, 1977, including quarterly technical progress report, October 1—December 31, 1977.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Aug 1978. Contract EX-76-C-01-1517. 164p. Dep. NTIS, PC A08/MF A01.

Progress in the renovation and reactivation of the Cresap coal liquefaction pilot plant is discussed. Severe winter weather has caused delays and checkout of some items showed that corrections were needed. The US DOE has changed the emphasis of this program so that it will concentrate on liquefaction operation and obtain equipment test data within the framework of normal operations. (LTN)

42197 (FE—1743-61) **Design and construction of the PDU for zinc halide hydrocracking of coal. Final report, Tasks 4 and 5.** Lindahl, D.R.; Echtler, J.P.; McGowan, R.F.; Schulz, C.A. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 8 Dec 1978. Contract EX-76-C-01-1743. 82p. Dep. NTIS, PC A05/MF A01.

This report presents the results of work to design and construct a Process Development Unit for the liquefaction of coal or extract to gasoline. The plant is designed to produce about 160 gallons per day of gasoline from 100 lb/hr feed using a zinc halide catalyst. Considerable flexibility was built into the plant to allow two modes of operation for both hydrocracking and regeneration of the zinc catalyst. Process flow diagrams with material balances are presented and process and instrument detail drawings are included.

42198 (FE—2044-44) **Partial liquefaction of coal by direct hydrogenation. Quarterly progress report, January—March 1979.** Falk, A.Y. (Rockwell International Corp., Canoga Park, CA (USA)). 1979. Contract EX-76-C-01-2044. 8p. Dep. NTIS, PC A02/MF A01.

Five reactor tests were conducted in the 1 TPH process development unit (PDU). Nominal test conditions for these and two previous tests are summarized. Preliminary analyses of the test results indicate carbon conversion results consistent with the trends shown in previous testing. Minor problems, primarily with the hot water and trace heating systems, have been encountered during these tests as the new product recovery system is being tuned up to achieve completely satisfactory operation. However, it appears that the product recovery system is functioning as planned. Fabrication of the heat recovery quench unit is in progress. This unit is being fabricated by Rockwell. Initiation of effort on the BTX recovery system and the A—E process study is still awaiting DOE contractual approval to proceed.

42199 (FE—2727-4) **Mass transport characteristics of zeolite cracking catalysts. Quarterly report, July 1—September 30, 1978.** Haynes, H.W. Jr. (Mississippi Univ., University (USA). Dept. of Chemical Engineering). 13 Oct 1978. Contract EF-77-S-01-2727. 30p. Dep. NTIS, PC A03/MF A01.

The modifications to the GC diffusivity apparatus and testing of the apparatus are complete. Preliminary experiments aimed at characterizing the extra-column residence times and variances have been completed and the results are documented in this report. A novel method for correcting for axial dispersion is also described. Results of a series of tests on the system n-butane/NaY zeolite are reported. The response curves for this system are indicative of a finite mass transfer rate, but further work is needed to determine whether the results may be affected by a nonlinear adsorption isotherm or nonisothermal effects resulting from the large heat of adsorption. The simulated catalytic cracking microreactor is in operation and some results from a series of shakedown runs are reported. Tests in which tetralin was cracked over NaY produced a product distribution similar to that which might be expected from mecha-

nisms involving both free radical (Rice—Kossiakoff) and carbonium ion cracking.

42200 (FE—3047-T1) **Temperature profiles in donor solvent liquefaction. Quarterly technical report No. 1, September—November 1978.** McIntosh, M.J. (Eyring Research Inst., Provo, UT (USA)). 1978. Contract ET-78-C-01-3047. 14p. Dep. NTIS, PC A02/MF A01.

The objective of this research is to study, experimentally, the effect of varying the temperature history of coal/donor-solvent slurries which are reacting chemically. The temperature history, or temperature profile, is to be varied in a systematic way while using a chromatographic characterization of the reaction products as a measurable effect. The chromatographic characterization is to be correlated with hydrogen consumption and product quality. It is believed that this search will allow temperature profiles to be found which are optimum with respect to product quality and hydrogen consumption. A kinetic mathematical model will be fitted to the data and used in the latter part of the project to facilitate the search for optimum profiles.

42201 (MERC/SP—78/4, pp 391-394) **Test valve design for letdown service Cresap Test Facility, Moundsville, West Virginia.** Berggren, G.A. (Fisher Controls Co., Marshalltown, IA). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

42202 (MERC/SP—78/4, pp 395-407) **Slurry impingement test evaluation of candidate materials for coal liquefaction letdown valves.** Mueller, J.J. (Battelle Columbus Labs., OH). 1978.

In Proceedings of the workshop on valves for solids handling service in coal conversion, November 14—16, 1977.

The results of the testing conducted to date point up the fact that commonly available ceramics and cemented carbide materials probably will not provide direct solutions to the problem of erosion encountered in single-stage throttling letdown of high pressure coal slurry. The improved erosion resistance of CVD SiC indicates the need to explore specialized structural forms of some of the available ceramic or ceramic-type materials. The excellent performance of the diamond product, which is commercially available, but only in limited size and shape, provides promise for the development of materials considerably more erosion resistant than the best cemented carbides currently being used in valves. The impingement test established in this work provides a simple and meaningful tool for evaluation of developmental materials and for screening materials prior to their being committed to actual valve performance evaluations.

42203 (ORNL/SUB—7240/5) **Converting the CRESAP test facility to a two-stage coal hydroliquefaction process. Phase A report.** Beskind, M.M.; Hammersley, R.C. (Scientific Design Co., Inc., New York (USA)). May 1979. Contract W-7405-ENG-26. 94p. Dep. NTIS, PC A05/MF A01.

This report contains a preliminary process design and cost estimate for the addition of a new coal extraction system to the Cresap, W.Va. pilot plant. The new facilities being considered would provide for direct contact of the coal slurry with a recirculating stream of hydrogen-rich gas at pressures in the range of 1350 to 2500 psig. Preliminary process flowsheets and planning drawings are included. Also included in this report is a discussion of the possibilities for continued component testing in the existing Cresap pilot plant.

42204 (PB—287799) **Environmental assessment data base for coal liquefaction technology: volume I. systems for 14 liquefaction processes. Final report Feb 77—Aug 78.** Koralek, C.S.; Patel, S.S. (Hittman Associates, Inc., Columbia, MD (USA)). Sep 1978. Contract EPA-68-02-2162. 204p. NTIS PC A10/MF A01.

The two-volume report, prepared as part of an overall environmental assessment (EA) program for the technology involved in the conversion of coal to clean liquid fuels, and the Standards of Practice Manual for the Solvent Refined Coal Liquefaction Process (EPA-600/7-78-091) represent the current data base for the EA of coal liquefaction technology. This volume summarizes pertinent information about 14 prominent coal liquefaction systems now being developed. For each system, it includes a brief description, a flow diagram, and a list of materials entering and leaving the system. Potential applicable control techniques are described generally, along with the current status and development plans for the 14 systems. The main conclusion from this volume is that these processes are not environmentally defined in the published literature; however, there is some indication that current development plans may help to correct this situation.

42205 (PB—287800) **Environmental assessment data base for coal liquefaction technology: volume II. Synthoil, H-Coal, and Exxon donor solvent processes. Final report Feb 77—Aug 78.** Parker, C.L.; Dykstra, D.I. (Hittman Associates, Inc., Columbia, MD (USA)). Sep 1978. Contract EPA-68-02-2162. 482p. NTIS PC A21/MF A01.

This volume is an environmental characterization of three selected coal liquefaction systems: Synthoil, H-Coal, and Exxon Donor Solvent. It documents and evaluates existing environmentally significant data. System characterization includes an integrated multimedia assessment of discharges to the environment from conceptualized 7,950 cu m (50,000 bbl) per day systems. Estimates are given for the raw waste streams, treatment and control processes, treated waste stream discharges, and the effects of these discharges on the environment. Conclusions include: (1) carbon-containing residues from process phase separations are major potential environmental problems; (2) except for solid carbon-containing residues from phase separations, treatment and controls exist for removing most major waste components--however, their efficiency in controlling coal liquefaction waste streams needs to be tested; and (3) less attention has been addressed to trace organic and inorganic compounds.

42206 (SAND—79-0085) **Coal liquefaction catalyst characterization.** Thomas, M.G.; Sample, D.G. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 63p. Dep. NTIS, PC A04/MF A01.

Catalysts evaluated in the Hydrocarbon Research, Inc. H-Coal Bench Unit testing program are characterized in both fresh and used conditions. The catalysts are metals (molybdenum, nickel, and cobalt) supported on alumina. Major changes in the catalysts during the tests include 4-8 w/o contaminant metals, 17-22 w/o coke, 15-25 w/o loss of catalytic metals, and 50% to 70% loss of surface area. The major elemental contaminants identified are carbon, hydrogen, sulfur, titanium, iron, boron, calcium, magnesium, and silicon. The hydrocarbon residue is uniformly distributed throughout, whereas the metals are restricted to the outer 300 μ of the catalyst. The sulfur is also distributed throughout the catalyst, and the distribution parallels Mo. A correlation of the form $Y = AX + B$ (where Y = w/o metals; X = weight loss upon ignition; and the regression coefficient B = 0.96) indicates that the concentrations of metal and hydrocarbon contaminants are related. Loss of Mo, Ni, and Co form the catalysts typically ranges from 10-20 w/o. This mobility of the catalytic metals is observed for Mo as crystal growth of MoS_2 in the outer regions of the catalysts; MoS_2 is also a major contributor towards ash in residues removed from catalyst surfaces. The surface area of the used catalysts is 30% to 50% that of the fresh catalysts and appears to be related most closely with the amount of coke. Pore volumes decrease in the used catalyst by as much as 80%, and distributions based upon regenerated catalysts suggest that the pores under 400 A radius are irreversibly affected. This paper represents one-half of a final reeport on mineral matter effects and catalyst characterization in coal liquefaction. The other half, covering mineral matter effects will be issued as a separate Sandia Laboratories Report: SAND79-0505.

42207 **Catalytic hydrotreating process.** Karr, C. Jr.; McCaskill, K.B. (to Dept. of Energy). US Patent 4,128,473. 5 Dec 1978. Filed date 5 Dec 1977. 16p.

PAT-APPL-857,718.

Carbonaceous liquids boiling above about 300°C such as tars, petroleum residuals, shale oils and coal-derived liquids are catalytically hydrotreated by introducing the carbonaceous liquid into a reaction zone at a temperature in the range of 300° to 450°C and a pressure in the range of 300 to 4000 psig for effecting contact between the carbonaceous liquid and a catalytic transition metal sulfide in the reaction zone as a layer on a hydrogen permeable transition metal substrate and then introducing hydrogen into the reaction zone by diffusing the hydrogen through the substrate to effect the hydrogenation of the carbonaceous liquid in the presence of the catalytic sulfide layer. (Official Gazette)

42208 **Comparison of methods for determining asphaltenes in coal-derived liquid fuels.** Schultz, H.; Mima, M.J. (Pittsburgh Energy Research Center, PA). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 76-78(1978). (CONF-780305—P5).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Methods of determining asphaltenes in coal liquids have been compared. Since there were significant differences in the results in half the comparisons, one can surmise that the analysis of coal liquids by different procedures is not satisfactory. The authors conclude that an acceptable standard method for the determination of asphaltenes in coal-derived liquids is urgently needed. (LTN)

42209 **Fundamentals of coal liquefaction.** Skidmore, D.R. Morgantown, WV; West Virginia Univ. (1977). 18p. (NP—23717). West Virginia Univ., Morgantown, WV.

Most discussions of coal structure and reactivity in hydrogen - donor solvents stress the network of C—C, C—O, C—H, C—N, and C—S covalent bonds and their contributions to chemical behavior. Largely overlooked are the contributions of numerous polar structures and their dynamic interactions with each other and with

solvents found effective for coal. Of special note are the oxidized lignites (leonardites) which dissolve or disperse at room temperature in aqueous caustic; coal materials which melt at coal conversion temperatures; coal reactions which occur at low temperatures with BF_3 and phenol; and similar reactions in short times with hydrogen, CO/steam and ammonia. Published data are selected to support the claim that polar bonds contribute significantly to coal structure and liquefaction reactivity. A natural coal ranking system is proposed.

PYROLYSIS AND CRACKING

42210 (CONF-790405—17) **Pyrolysis of blocks of Texas lignite.** Westmoreland, P.R.; Dickerson, L.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

From AICE meeting; Houston, TX, USA (1 Apr 1979).

Pyrolysis experiments using blocks of Texas lignite have provided new and useful input to models of in-situ gasification. Important thermal and reaction effects were observed in these experiments that are not observed in powder pyrolysis, which minimizes internal heat and mass transfer resistances. These effects should be included in applying powder data to in-situ gasification of wet, monolithic coal. Internal temperatures and product yield structures were measured during the controlled heating of 0.15-m-diam (6-in) cylindrical blocks under inert gas or hydrogen. At atmospheric pressure, the block surface temperature was increased at a constant rate (0.3 to 10 K/min or 0.5 to 18°F/min) from 298 K (77°F) to maximum temperatures of 873 to 1273 K (1112 to 1832°F) before internal temperatures were permitted to equilibrate. Because of the low thermal conductivity of dry coal and the consumption of heat at the drying front, steep temperature gradients formed even at heating rates as low as 3 K/min. As a result, steam generated from natural moisture content escaped through the thermal gradient, contacting and gasifying carbon in the hotter surface region. Hydrogasification, carbon deposition (possibly from cracking of tars), and char pyrophoricity were also observed.

42211 (FE-MIT—2295T27-6) **Coal pyrolysis by hot solids from a fluidized bed combustor. Quarterly progress report, September 1—November 30, 1978.** Longwell, J.P.; Howard, J.B.; Peters, W.A.; Yeboah, J.Y.; Nwalor, J.; Brundage, S. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1978. Contract EX-76-C-01-2295-027. 12p. Dep. NTIS, PC A02/MF A01.

This quarter was spent primarily on data reduction and analysis. The computational procedure for the gas yields and composition were completed. Data reduction for the experiments with Texas Lignite were completed. All yields were computed on a dry-ash free basis. Liquor was defined as the water and water solubles condensed in the collection traps plus the water in the gas product measured by the gas chromatograph. Gas yields were determined from the integral of a plot of the generation rates as a function of time (previous progress reports reported it by difference). The results of the experiments with Texas Lignite indicate that the presence of calcined dolomite can result in significant shifts in the fraction of the coal heating value going to gas and liquid products and also demonstrate removal of H_2S and CO_2 from the gas. It is seen that with the addition of dolomite the fraction of the coal heating value in gas increases by 25 to 35% while at the same time the volumetric heating value of the gas increases by 15 to 35%. This increase is due to a combination of CO_2 removal and a higher hydrocarbon content. Tar yields decrease significantly indicating some cracking activity of the dolomite as compared to sand. Further work includes completing workup and interpretation of the data and an approximate assessment of the practical potential of the substantial increase in gas quality.

42212 (METC/RI—79/2) **Assessment of flash pyrolysis and hydropyrolysis.** Belt, R.J.; Bissett, L.A. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Jul 1978. 69p. Dep. NTIS, PC A04/MF A01.

This report summarizes the major developments in flash pyrolysis and hydropyrolysis during the last fifteen years. Eight methods of heating are reviewed: (1) laser, (2) microwave, (3) flash tube, (4) plasma, (5) electric arc, (6) shock tube, (7) electric current, and (8) entraining gas. Despite the number of studies and number of techniques used to investigate the flash heating of coal, the reaction mechanisms and kinetics remain poorly understood. The report recommends that studies be conducted to build a data base for several coal types and for a range of conditions that are of current practical interest. In addition, exploratory research into the extreme limits of flash pyrolysis and hydropyrolysis should be done in order to gain mechanistic insights. Special emphasis should be placed on resolving the effect of heating rate on overall conversion and product distribution.

SOLVENT EXTRACTION

42213 (BMFT-FB-T—78-53) **Physical and chemical investigations on bituminous coal extracts and their fractionation.** Salinger, A. (Technische Univ. Berlin (Germany, F.R.)). Dec 1978. 129p. (In German). Dep. NTIS (US Sales Only), PC A07/MF A01.

The extraction of bituminous coal with thionyl chloride leads to a higher yield in comparison with other simple solvents. The yield of extraction shows a dependence of the rank of coal. The interaction of the solvent with coal was interpreted as a simultaneous chemical reaction and absorption of solvent molecules. By the help of a balance procedure it was possible to eliminate the solvent interaction and to conclude an average molecular formula of the coal. The coal-thionyl chloride extracts were parted by different solvents in 16 different fractions.

PROPERTIES

REFER ALSO TO CITATION(S) 42164, 42170, 42208, 42253

42214 (COO—0063-10) **Hydrogen bonding in asphaltenes and coal. Quarterly report, July 1—September 30, 1978.** Li, N.C.; Tewari, K.C. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 29 Sep 1978. Contract EY-76-S-02-0063. 23p. Dep. NTIS, PC A02/MF A01.

Two coal liquid products derived from the same Kentucky hvAb coal have been separated into toluene-insoluble, asphaltene, and pentane-soluble heavy oil fractions. Viscosity and calorimetric studies are reported of the interaction between heavy oil and asphaltene(A) and its acid/neutral (AA) and base (BA) components in solvent benzene. The increase in viscosity and molar enthalpy of interaction, ΔH^0, in order BA > A > AA, correlate well with the proton magnetic resonance downfield chemical shift of the OH signal of o-phenylphenol, as a function of added asphaltene (A, AA, BA) concentration in solvent CS_2. The results suggest that when asphaltene and heavy oil are present together, hydrogen-bonding involving largely phenolic OH, is one of the mechanisms by which asphaltene—heavy oil interactions are achieved and, in part, is responsible for the viscosity increase of coal liquids.

42215 (DOE/ET—0045/1) **Analyses of tipple and delivered samples of coal collected during fiscal year 1978. Report of investigation.** (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Extraction). May 1979. 21p. Dep. NTIS, MF A01.

Portions of document are illegible.

This Department of Energy publication updates a series of Reports of Investigation on the quality of coal purchased under specifications for Government use. Listed in alphabetical order by state, county, town, and mine is analytical data on the composition and quality of tipple and delivered samples of coal collected during fiscal year 1978. Tipple samples were collected by a commercial laboratory under contract in accordance with instructions furnished by the Coal Sampling and Inspection Office. The delivered samples were collected at destination by installation personnel, and all samples were analyzed in the DOE laboratory located in Pittsburgh.

42216 (EPRI-AF—960) **Coal structure and coal liquefaction. Final report.** Deno, N.C.; Greigger, B.A.; Jones, A.D.; Rakitsky, W.G.; Stroud, S.G. (Pennsylvania State Univ., University Park (USA)). May 1979. 35p. Dep. NTIS, PC A03/MF A01.

This project was based on a discovery that mixtures of hydrogen peroxide, trifluoracetic acid, and sulfuric acid dissolved coals to give colorless solutions. In this oxidation, the aliphatic components were largely preserved. Project objectives were: (1) to optimize the method, (2) to determine the reproducibility, and (3) to apply the method to coals and coal derived liquids for the purpose of determining their chemical structure. The third objective is a major one in which this EPRI project has provided a start and which is being continued in a Department of Energy project. Early results show that coals have widely varying chemical structures and that dramatic structural changes occur upon liquefaction. It is expected that the method will become the major method for elucidating the chemical structure of coals.

42217 (FE—2205-15) **Investigation of the mechanism of fly-ash formation in coal-fired utility boilers. Annual and Quarterly report, February 1, 1978—January 31, 1979 and November 1, 1978—January 31, 1979.** Ulrich, G.D. (New Hampshire Univ., Durham (USA). Dept. of Chemical Engineering). 20 Feb 1979. Contract EX-76-C-01-2205. 14p. Dep. NTIS, PC A02/MF A01.

Laboratory flame measurements, equilibrium predictions, and a char-ash vaporization mechanism were employed to generate primitive predictions for the size, quantity and composition of condensation ash in cyclone and pulverized-fuel fired boilers. These were compared with characteristics of the submicron fraction separated from plant samples. Agreement was good in terms of particle

size, morphology, and concentration. The predicted depletion of aluminum and enrichment of silicon were also observed, but the measured depletion of iron was contrary to predictions. Hopper ash from the Monroe Station, a PF unit burning coal similar to the Merrimack Station, was examined briefly. The submicron fraction was negligible compared to that in the Merrimack unit. The difference was attributed to lower combustion temperatures employed in PF firing. Predictions for the two boilers confirm these findings. The growth model was further refined with completion of a computer code which predicts primary-particle and aggregate growth. It encompasses a broad range of conditions in both Brownian regimes and the transition ranges.

42218 (FE—2537-8) **Characterization of coal-derived liquids and other fossil fuel related materials employing mass spectrometry. Quarterly report, June 30—September 29, 1978.** Scheppele, S.E. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). 1 Dec 1978. Contract EX-76-S-01-2537. 24p. Dep. NTIS, PC A02/MF A01.

Oklahoma State University completed the installation of an environmental control system for the mass spectrometer laboratory. The all-glass, heated inlet system was modified in order to both increase the range of molecular weights which can be introduced into the ion source and to allow for the rapid introduction of known quantities of solids and liquids. This was accomplished by adding a sample vacuum lock to the expansion volume and by modifying the cover plate which extends from the ion source housing to the ion source block. Considerable activity was devoted to evaluating the performance of the DS-50S data acquisition system in combination with the CEC 21-110B double focusing mass spectrometer in regard to mass measurement accuracy, dynamic resolution, and sensitivity. Electron impact (70-eV) mass spectra were acquired at scan speeds of 45, 88, and 156 seconds/decade using a static resolution of 13,000. The accuracy of ion masses obtained from the average of 8 to 10 mass spectra acquired in real time is typically 5 ppM. The average mass measurement accuracy was found to be essentially independent of the rate at which the magnetic field was scanned. A dynamic resolution of at least 8,500 was demonstrated for scan speeds of both 88 and 156 seconds/decade. In regard to development of micromolecular probe distillation in combination with field-ionization mass spectrometry for quantitative analysis, the temperature controller was received and interfaced to the NOVA 3/12 via the auxiliary board in the AEI interface. Computer technology is thus used to acquire both the temperatures and the field-ionization mass spectra of the distillates and to process the acquired data. Determination of accurate quantitative distributions using the automated technique was demonstrated for a variety of samples.

42219 (FE—2721-T1) **Utilization of coal associated minerals. Quarterly report No. 5, October 1—December 31, 1978.** Slonaker, J.F.; Alderman, J.K.; Buttermore, W.H.; Grady, W.C.; McMillan, B.G.; Muter, R.B.; Simonyi, T.A. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 28 Mar 1979. Contract EF-77-S-01-2721. 36p. Dep. NTIS, PC A03/MF A01.

Laboratory analysis of physical and chemical properties has continued on representative samples of plant feed coal as well as washed coal and refuse from the Pittsburgh seam. Preliminary laboratory analysis has been obtained for samples procured from the fluidized bed process at Rivesville, West Virginia. Representative samples of the feed limestone, the feed coal, the spent limestone bed material or bottom ash and flyash from the carbon burn-off cell were examined. A financial report and a milestone progress chart are appended.

42220 **Symposium on new analytical methods applied to fuels and fuel processing. Symposium on environmental aspects of fossil fuel processing.** Washington, DC; American Chemical Society (1979). 283p. (CONF-780305—P5). University Microfilms, Ann Arbor, MI $8.00.

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The American Chemical Society, Division of Fuel Chemistry, Symposium on new analytical methods applied to fuels and fuel processing and symposium on environmental aspects of fossil fuel processing was held at Anaheim, California, March 12—17 1978. Four papers have been entered individually into the data base. Twenty-four papers had been entered previously from other sources. (LTN)

42221 **Analysis of twenty-three West Virginia coals.** Smith, W.M.; Kim, Y.N. Morgantown, WV; West Virginia Univ. (1978). 57p. (NP—23728). West Virginia Univ., Morgantown, WV.

This report contains a list of twenty-three samples covered, providing information as to seam name, collection date, county and mine permit number. Sample collection was performed by crews containing at least one geologist. Sample processing was performed in strict accordance with ASTM procedural rules (designation 2013-72).

42222 **Testing the expansibility of hard coal under the influence of water vapor.** Ceglarska-Stefanska, G.; Czaplinski, A. *Zesz. Nauk. Akad. Gorn.-Hutn. Stanislawa Staszica, Gorn.;* **571**: No. 85, 61-73(1977). (In Polish).

Water vapor sorption isotherms, and the course of expansion and contraction during sorption of water vapor, were determined for nine Polish hard coals of different ranks. The sorptive capaciiy and the expansion decrease in the degree of metamorphism. No dependence of expansion on the bedding direction was found. The return of the samples to their initial dimensions after desorption confirms that water vapor had been adsorbed.

42223 **Application of sorption methods to testing of the structure of hard coal and its carbonization products.** Cembroniewicz, A. *Zesz. Nauk. Akad. Gorn.-Hutn. Stanislawa Staszica, Gorn.;* **571**: No. 85, 75-83(1977). (In Polish).

The sorptive properties of Czech hard coals and the products of their carbonization were determined. The specific surfaces obtained from the adsorption of methanol at 25°C are approximately two orders of magnitude greater than those determined from the isotherms of nitrogen and krypton adsorption at the temperature of liquid nitrogen. The sorptive capacities of the samples change considerably with increase in carbonization temperature reaching a maximum for products carbonized at 750°C.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42217, 42253, 42264, 42268

42224 (ANL/EES-TM—43) **Effects of fertilizer made from flue gas and fly ash on selected crops and soils. Summary report.** Master, W.A.; Zellmer, S.D. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 28p. Dep. NTIS, PC A03/MF A01.

A desulfurization process was developed for the Illinois Institute of Natural Resources to reduce stack emissions from a typical coal-fired boiler and to produce a new fertilizer product utilizing flue gases, fly ash, bottom ash, and materials added during the scrubbing process. Argonne National Laboratory (ANL) carried out the testing on the fertilizer products; the major objectives of ANL's research were: (1) to physically and chemically analyze the fertilizer products; (2) to analyze the effect of the fertilizer products on selected Illinois crops; and (3) to assess the usefulness of the fertilizer products as amendments for acid-mine spoils. The seven batches of fertilizer product received by ANL were analyzed for physical and chemical parameters, and three plant growth experiments were carried out to determine the effects of the fertilizer products on soybeans, spring or winter wheat, and smooth bromegrsss. The concentrations of elements varied widely between fertilizer batches. The single fertilizer product with bottom ash contained the highest concentrations of numerous trace elements. The growth experiments demonstrated that a single application equivalent to 224 kg N/ha of the fertilizer product will increase aerial biomass and crop yield as compared to unfertilized conditions. However, the ratio of harvestable grain to aerial vegetation may be reduced, and the development of root systems may be adversely affected. Further greenhouse and field testing will be necessary to fully assess the value of the fertilizer products.

42225 (FE—2240-13) **Problems associated with controlling sulfur emissions from high-Btu coal gasification plants. Interim report.** Atkins, W.T.; Takach, H.J. (Braun (C.F.) and Co., Alhambra, CA (USA)). Aug 1978. Contract EX-76-C-01-2240. 46p. Dep. NTIS, PC A03/MF A01.

The control of sulfur emissions from coal gasification plants is a complex problem. At some point more stringent sulfur emission standards for high Btu coal gasification process streams may result in a net increase in sulfur emissions from the entire complex. The benefit of sulfur control on process streams can only be evaluated after a thorough study of the effects of trace components on sulfur recovery plant performance and the calculation of total sulfur emissions from all sources. To impose treatment standards based solely on technical accomplishments in a parallel industry without regard to net environmental benefit or the associated energy or economic penalty or without complete understanding of the role of trace components on performance could adversely affect the emerging coal gasification industry and ambient air quality.

42226 (FE—2240-51) **Sulfur removal from flue gas. Final report.** Hancock, B.L. (Braun (C.F.) and Co., Alhambra, CA (USA)). Sep 1978. Contract EX-76-C-01-2240. 52p. Dep. NTIS, PC A04/MF A01.

Environmental regulations limit the quantity of sulfur dioxide in the combustion gases of fossil fuel fired utility boilers. This report presents an economic comparison of various flue gas desulfurization processes for coal gasification plant boilers. The FMC Double Alkali process had the lowest total of capital cost plus 4 years' operating

costs for both eastern and western coal. The nearest competitor had approximately 15 percent higher total cost. The Double Alkali process has not been tested on low sulfur coal at a commercial scale. The operating experience on flue gas from high sulfur coal is favorable. The economics could be less favorable if the sludge requires conditioning prior to disposal. Among the regenerable processes studied the UOP/SFGD process had the lowest total of capital cost and 4 years' operating costs. The UOP/SFGD process has good operating experience on flue gas from high sulfur oil.

42227 (FE—2721-3) **Utilization of coal associated minerals. Quarterly report No. 3, April 1—June 30, 1978.** Buttermore, W.H.; McMillan, B.G.; McClung, J.D. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 15 Sep 1978. Contract EF-77-S-01-2721. 22p. Dep. NTIS, PC A02/MF A01.

The purpose of this research program is to examine the effects of coal mineral materials on coal waste by-product utilization and to investigate new and improved methods for the utilization of waste by-products from the cleaning, combustion and conversion processing of coal. This effort will include the examination of the effects of cleaning and processing by gasification and combustion on coal mineral materials and the changes which occur in the wastes produced by cleaning and processing (by gasification and combustion) due to changes in the form and distribution of coal mineral materials in feed coals.

42228 **Coal refuse disposal. Report No. 137.** Akers, D.J. Morgantown, WV; West Virginia University (1977). 12p. (CONF-7704111—1).

From 52. annual meeting of the WV academy of science; Salem, WV, USA (1 Apr 1977).

Problems posed by the surface disposal of coal wastes include the nonproductive use of land, the loss of aesthetic value, the danger of slides, and both air and water pollution. These problems may be difficult to control in an existing, poorly designed refuse pile; however, they can be largely avoided in a new pile through careful planning. The first step in planning a refuse disposal site or additions to an existing site is to become familiar with all waste disposal regulations. There are both Federal and State laws presently in force regulating the construction of a refuse pile and the trend appears to be toward increasing regulation. The best source of information concerning Federal Regulations is the United States Department of the Interior Mining Enforcement and Safety Administration (MESA). State regulations can also generally be obtained through a local MESA office. The acceptability of the waste for disposal on a refuse pile should be determined with respect to the overall disposal costs. These include the costs of the preparation process, material handling costs, and the cost of maintenance over a long period of time. Generally, a well-sorted granular material with a low moisture content, e.g., with 8 to 12 percent moisture on the basis of the weight of the dry solids, will be the most suited for disposal on a refuse pile. In the construction of a new refuse pile, the importance of detailed site evaluation and design cannot be over emphasized. The site selected and the design of the pile should be such that there is a maximum utilization of the site with a minimum amount of degradation of the environment and danger to human health and safety.

42229 **Role of flyash brick manufacturing in energy conservation.** Slonaker, J.F. Morgantown, WV; West Virginia Univ. (1977). 7p. (NP—23716). West Virginia Univ., Morgantown, WV.

This report describes the areas in which energy savings can be realized when manufacturing flyash brick. There are several factors which contribute to the energy savings, but perhaps the largest factor is that flyash has undergone considerable heat work in the electric utility boiler and is a pre-fired raw material. Little additional heat work is required to form the ceramic bonds necessary to produce a superior quality brick.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42191, 42204, 42205, 42220, 42247, 42271, 42853, 43245, 43246, 43732, 43747, 43751, 43754, 43785

42230 (CONF-790458—2) **Assessing the air quality related impacts of coal conversion facilities.** Kornegay, F.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From Symposium on environmental and climatic impact of coal utilization; Williamsburg, VA, USA (17 Apr 1979).

In an effort to assess the impacts of coal conversion facilities, Oak Ridge National Laboratory has assembled a multi-disciplinary team of experts to assess the air-quality-related effects of the Department of Energy demonstration facilities. The goal of the study is to quantify the emissions of the various processes, estimate the average and worst-case ground-level concentrations resulting from plant operations, determine the potential effects of such concentrations upon the environment, and design a preoperational and operational monitoring program to determine the actual impact of the facility. As no commercial-scale conversion ventures are presently in operation, the team relies upon laboratory and pilot-plant experiences to determine probable emissions, emission rates, and potential mitigative measures. The toxicity of the various effluent streams, including potential synergistic effects, is estimated by ecological experts. As the chemicals of maximum interest are determined, pilot plant monitoring programs are suggested to allow ambient levels to be estimated before plant construction. Given realistic estimates of pollutant emission rates, the heat, velocity, and physical characteristics of the emission streams, and the meteorological features of the proposed facility, ground-level concentrations of various pollutants are estimated. A detailed dispersion model is used to estimate the site-specific impacts. Additionally, a regional model utilizing source terms from all other major emitters in the affected area is used to determine the total impact of the proposed facility in conjunction with present facilities. These estimates of ground-level concentrations of the chemicals emitted by a proposed facility are then used to determine the probable effects upon soils, flora, fauna, and future development of the area due to the operation of that facility.

42231 (DOE/EDP—0046) **Environmental development plan, Fossil Fuel Utilization Program.** (Department of Energy, Washington, DC (USA)). Apr 1979. 101p. Dep. NTIS, PC A06/MF A01.

Environmental Development Plans (EDPs) are prepared by the Department of Energy (DOE) to help fulfill the Department's responsibility for thedevelopment of environmentally acceptable energy technologies. The EDP provides a common basis for planning, managing, and reviewing all environmental aspects of the energy programs under DOE's jurisdiction. The EDP is timed to precede key technology program decisions as the technology moves from the exploratory development stage to an engineering development or technology demonstration phase. Each EDP identifies the environmental concerns and research and development necessary for assessing the potential environmental impacts and mitigating measures associated with an energy technology. Thus, to ensure that environmental, health, and safety (EH&S) considerations will be addressed adequately in the technology decisionmaking process, the EDP (1) identifies and evaluates EH&S concerns; (2) defines EH&S research and related assessments to examine or resolve the concerns; (3) provides a coordinated schedule with the technology program for required EH&S research and development; and (4) indicates the timing for Environmental Assessments, Environmental Impacts Statements, Environmental Readiness Documents, and Safety Analysis Reports.

42232 (FE—2445-1(Vol.1)) **Water related environmental effects in fuel conversion. I. Summary volume.** Gold, H.; Goldstein, D.J. (Water Purification Associates, Cambridge, MA (USA)). 1978. Contract EX-76-C-01-2445. 259p. Dep. NTIS, PC A12/MF A01.

This report examines some water related effects that could be expected from siting specific conversion plants at given locations in the major coal and oil shale bearing regions of the United States. A total of 90 plant-site combinations were studied: 48 in the Central and Eastern regions and 42 in the Western region. The synthetic fuel technologies examined include: coal gasification to convert coal to pipeline gas; coal liquefaction to convert coal to low sulfur fuel oil; coal refining to produce a de-ashed, low sulfur solvent refined (clean) coal; and oil shale retorting to produce synthetic crude. The results presented include the range of water requirements, the conditions for narrowing the range and optimizing the use of water, the ranges of residual solid wastes, and the cost and energy requirements for wastewater treatment. A comparison of the water requirements with those of two recently published studies shows widely varying estimates and emphasizes the need for both site- and design-specific calculations. A general assessment of the water resources data in the coal and oil shale regions was made. Potential water supply sources for each site were evaluated in terms of the available water supply. The degree of wet cooling used to dissipate waste heat was determined on the basis of water availability and cost.

42233 (FE—2495-T13) **Test of the draft guidelines for multimedia environmental monitoring of Department of Energy fossil energy RD and D facilities.** Rolan, R.G. (Dalton-Dalton-Little-Newport, Cleveland, OH (USA)). Dec 1978. Contract EX-76-C-01-2495. 229p. Dep. NTIS, PC A11/MF A01.

Draft guidelines for multimedia environmental monitoring, developed for the Office of Fossil Energy, Department of Energy, were tested by applying them to a hypothetical coal gasification facility. This report is divided into two parts: (1) a discussion of the way in which the Guidelines were implemented, problems involved in their implementation, and recommended revisions, and (2) a presentation of the detailed monitoring plan developed for the facility. The scenario selected for testing the Guidelines was a demonstration-scale facility based on the CO_2 Acceptor process, located at a surface coal mine near New Athens, Illinois. The work program assumes three two-year stages of facility development: the

baseline phase (prior to construction), the construction stage, and the early operations stage. A detailed plan for environmental monitoring at the hypothetical coal gasification facility was prepared, using the draft Monitoring Guidelines. In cases where the draft Guidelines would result in an incomplete, uneconomical or unrealistic monitoring program, these difficulties were identified and appropriate revisions of the Guidelines were noted. The detailed monitoring plan reflects the recommended revisions of the Guidelines.

42234 (METC/RI—79/3) **Kinetics and reaction products of aerobic pyrrhotite (FeS) hydrolysis at ambient temperatures.** Case, G.D.; Farrior, W.L.; Green, D.A.; Stewart, G.W. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Mar 1979. 38p. Dep. NTIS, PC A03/MF A01.

The product distributions and mechanisms of FeS hydrolysis were examined as a function of pH, NH_4^+ ion concentration, and SO_2/sulfite concentrations in aqueous suspensions. Products in the solution phase as well as precipitates and starting material residues were examined by pH and redox potentiometry, x-ray diffraction, x-ray fluorescence, scanning electron microscopy, infrared spectrometry, and wet chemical methods. Principal products of pyrrhotite hydrolysis included soluble SO_4/sup =/, Fe^{2+}, and lepidocrocite (FeOOH). In an unbuffered acid medium, equimolar leaching of iron and sulfur from FeS gives these plus some evolved H_2S as the only products. Hydrolysis in unbuffered water yields the same products with the exception of H_2S, with an atom ratio of Fe:S leached of 3.5 to 1. Surface pyrite (FeS_2), S^0, and S-rich sulfides are not observed. Hydrolysis in ammonia at pH = 9 gives rise to equimolar FeS leaching to form $Fe(OH)_2$, FeO(OH), and SO_4/sup =/ as the only products. Hydrolysis in a bisulfite buffer (pH = 6) gives Fe^{2+} plus lesser amounts of FeO(OH), FeO, and $Fe_2(SO_4)_3$. Thermodynamic and kinetic considerations, extended to present conditions, predict FeO(OH), Fe^{2+} and SO_4/sup =/ as the principal products. The kinetics of iron sulfide hydrolysis are exceedingly slow. In no case did more than 2 percent of the original FeS leach even after 6 days.

42235 (PB—287363) **Reservoir ecosystems and western coal development in the Upper Missouri River basin: a summary report.** Nelson, W. (Fish and Wildlife Service, Fort Collins, CO (USA). Western Energy and Land Use Team). Jul 1978. 16p. NTIS PC A02/MF A01.

This report, the result of a one-year literature and field survey in areas of planned and existing development, presents an ecological overview evaluating the limnology, water chemistry, and fisheries of lakes Fort Peck and Sakakawea. Specifically, the survey provides an overview of baseline conditions, describes various developments and their impacts, identifies mitigation measures, and delineates further research needs. Additionally, the data collected over the study year from the two upper impoundments, Lake Peck and Lake Sakakawea, is compared with the more comprehensive data compiled over a period of several years on the lower four reservoirs to determine the extent of the physical, chemical and biological similarity among the respective systems.

42236 (PB—287730) **Pollutants from synthetic fuels production: facility construction and preliminary tests. Phase report, November 1976—April 1978.** Cleland, J.G.; Mixon, F.O.; Nichols, D.G.; Sparacino, C.M.; Wagoner, D.E. (Research Triangle Inst., Durham, NC (USA)). Aug 1978. 128p. NTIS PC A07/MF A01.

The report describes the facility construction and gives results of preliminary tests for a project that seeks a fundamental understanding of the factors and conditions that cause the production of environmental pollutants in synthetic fuels processes. Tasks include: operation of a laboratory-scale coal gasification facility; collection and chemical analysis of effluent stream samples; compilation and analysis of resulting data; and evaluation of these data. The experimental system operates successfully and reliably at gasification temperatures up to 1370 K, pressures up to 1.2 MPa, and gas generation rates of about 20 standard liters/min. Analytical chemical methods, developed for analysis of effluents from these coal gasification tests, promise to achieve the required levels of sensitivity and extent of compound identification and quantitation. For example, liquid chromatography/mass spectrometer/computer analysis is used to quantitate organic compounds. The major pollutant classes are benzene and its substituents, thiols and sulfides, phenols, fused polycyclics, sulfur heterocyclics, and inorganic sulfur compounds.

42237 (UCRL—81970) **Two-dimensional transient dispersion and adsorption in porous media.** Homsy, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Apr 1979. Contract W-7405-ENG-48. 11p. (CONF-790630—3). Dep. NTIS, PC A02/MF A01.

From 5. underground coal conversion symposium; Alexandria, VA, USA (18 Jun 1979).

We modeled contaminant transport in an underground aquifer following in situ coal gasification to determine the environmental impact on ground water. We treated the aquifer as a semi-infinite porous medium, bounded on top and bottom by impermeable parallel walls. Line, plane and finite-volume sources were studied. The two-dimensional convective-dispersion equation, which governs the rate of contaminant transport, was reduced to an ordinary differential equaton and solved for an instantaneous source. Asymptotic series solutions valid for short and long times are given for a continuous-line source. We conducted a case study characteristic of actual conditions encountered at the Hoe Creek I in situ coal gasification site in Gillette, Wyoming, where we are currently doing field experiments. A breakthrough curve and a plan view of the plume development display the results for transport of phenol and Ca^{++}. The plan view shows lines of constant, maximum allowable concentration at various times after gasification. These lines are initially ellipsoidal and stretch out downstream with time. Finally, when all the contaminant dissolves in the gasification zone, the source disappears and the contaminant concentration field gradually returns to zero.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 43869, 43870

42238 (RLO—2229/T15-3) **Comprehensive bibliography and index of environmental information for the Beluga-Susitna, Nenana, and Western Arctic coal fields.** Buck, E.H.; Allen, A.; Olshansky, R.B.; Pennell, S.H. (Alaska Univ., Anchorage (USA). Arctic Environmental Information and Data Center). Jun 1978. Contract EY-76-S-06-2229-015. 192p. Dep. NTIS, PC A09/MF A01.

Section I of this index is the master bibliography, which contains a complete bibliographic citation for each document listed in numeric order according to its accession number. Section II is an alphabetical author index. Section III is a geographic index. Section IV consists of three maps of the areas covered by the geographic index. Section V is an earth sciences index. Section VI is a biological (taxonomic) index. Section VII is a general keyword index. All keywords are listed alphabetically with accession numbers of citations containing relevant information.

42239 (RLO—2229/T15-4) **Comprehensive bibliography and index of environmental information for the Beluga-Susitna, Nenana, and western arctic coal fields. Volume II.** Buck, E.H.; Allen, A.; Olshansky, R.B.; Pennell, S.H. (Alaska Univ., Anchorage (USA). Arctic Environmental Information and Data Center). Sep 1978. Contract EY-76-S-06-2229-015. 182p. Dep. NTIS, PC A09/MF A01.

The bibliography and index were compiled to provide increased access to environmental information pertinent to three major coal areas in Alaska. Often information necessary for adequate decision-making on large projects is scattered throughout many documents. This bibliography and index compile pertinent information and facilitate access to many publications. Section I of this index is the master bibliography, which contains a complete bibliographic citation for each document. Each citation is listed in numeric order according to its accession number. All the indexes in this document refer to this unique accession number. New additions to the bibliography will continue the numerical sequence. Section II is an alphabetical author index. Section III is a geographic index. Section IV consists of three maps of the areas covered by the geographic index. Section V is an earth sciences index. Section VI is a biological (taxonomic) index. Section VII is a general keyword index.

42240 **South African coal: challenge to Petrick findings.** Friedland, R.J. *Energy Policy;* 7: No. 1, 71-72(Mar 1979).

The Petrick Commission's coal-reserve estimates for South Africa led to the prediction in its report that output would peak in about 50 years. Some recent shifts in pricing policy, expected developments in extraction technology, and additions to reserves, suggest that Petrick's assessment of recoverable reserves was too pessimistic.

42241 **Coal resources: a Latin American view.** Alvarado, B. *Interciencia;* 3: No. 6, 366-375(Nov 1978). (In Spanish).

The figures of world coal resources vary from 11×10^{12} and 23×10^{12} tons. In Latin America, which only has about 0.6% of the world coal resources, it is believed that uncertainty is even greater. The figures given recently by the quoted organizations, as well as by ECLA and ILAFA vary between 30,000 and 70,000 million tons, which are found in only seven countries. Coal deposits in Argentina, Brazil, Chile, Mexico, Peru and Venezuela are briefly described on the basis of recent publications of the ILAFA-CCAL Congress carried out in Mexico in 1976. In the other Latin American countries, with the exception of Colombia, there are only insignificant amounts of coal, of no economic value. It is emphasized that, of all Latin American countries, Colombia has the most varied and abundant coal resources, which fully justifies the interest shown in their exploitation by many industrialized countries and even by some Latin American neighbors. Although coal beds are extensively distributed and the quality of coking coal high, its development has been slowed down by the bottleneck of internal transport and the

lack of appropriate ports. The Government of Columbia is conscious of the lack of exploration and carries out an intensive study campaign through the State organization call INGEOMINAS and CARBOCOL, as well as with some important foreign companies associated with CARBOCOL. The conservative estimates made by INGEOMINAS show that, in the 35 basins thus far investigated, there are nearly 7 million tons of reserve and a total of 40 million tons of potential resources. The annexed map and table show the site andaccess to the basins, the exact stage of their exploration, the quality of the coal and the type of reserves studied. International nomenclature is followed throughout.

MINING

REFER ALSO TO CITATION(S) 42220, 42272

42242 (AED-Conf—78-178-005) **Rheinbraun-model: protection of internal decisions by automated acquisition and evaluation of the daily routine in brown coal surface mining facilities.** Dermietzel, E. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 21p. (In German). (CONF-7803100—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on models and techniques to secure decisions; Essen, F.R. Germany (2 Mar 1978).

The tasks of company's management, including decision problems concerning management and production planning, are discussed with regard to brown coal surface mining. Particular emphasis is laid on the information situation and the anticipation for decisions of management planning and control, the improvement of the information situation by automated operation control, and the mining-oriented operation planning in the Rheinbraun surface mining facilities.

42243 (BM-RI—8359) **Drainage of methane from the overlying Pocahontas No. 4 coalbed from workings in the Pocahontas No. 3 coalbed.** Finfinger, G.L.; Cervik, J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Mining and Safety Research Center). 1979. 19p. Bureau of Mines, Washington, DC.

The Bureau of Mines conducted an experimental degasification project in Island Creek Coal Co.'s Virginia Pocahontas No. 5 mine. Methane from the overlying Pocahontas No. 4 coalbed was entering mine workings in the Pocahontas No. 3 coalbed through fractures in the roof rock. Small-diameter (1-5/8-inch) holes were drilled into the overlying coalbed to reduce the gas pressure and intercept methane flows, which were piped to the surface through an underground 6-inch-diam steel pipeline. The total methane flow rate from the vertical holes averaged 150,000 ft^3/day for the first month. Methane flows into the mine were reduced by 47%, thereby demonstrating the effectiveness of this form of degasification in reducing ventilation requirements and providing a safer working environment.

42244 **Dry-feed spray system for coal mine sealants.** *Bur. Mines Technol. News;* No. 62, 2(Feb 1979).

The two-channel nozzle of this spray discharges two separate flows, a mixture of air and dry sealant from a central cylinder, and an encircling spray of water from a concentrically mounted water ring (a ring-shaped manifold). Downstream of the nozzle, the water mixes with the air and sealant to form a wet sealant spray that adheres to mine surfaces with very little rebound. Extensively modified commercial spray machines are used to feed the sealant to the spray nozzle smoothly, without raising dust. Plugging of the nozzle is practically eliminated by two self-cleaning design features of the nozzle. This spraying system was developed by the Bureau of Mines Spokane Mining Research Center in cooperation with Unisul Inc. The Bureau's experiments began with testing and modifying commercially available equipment and sealants. More than 52 sealant mixtures, several nozzle configurations and different sizes of mineral wool nodules were tested. The system is now being used experimentally by the Westmoreland Coal Company in their Eccles No. 6 Mine near Beckley, West Virginia. Demonstrations of the spray system were also given to mining industry representatives this year by personnel of the Spokane Mining Research Center. Similar spraying machines are now commercially available from Unisul Inc. of Winterhaven, Florida.

42245 (DOE/TIC—10128) **Methane recovery from coalbeds project technology test projects evaluation of candidate projects.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Feb 1979. Contract EW-78-C-21-8089. 26p. Dep. NTIS, PC A03/MF A01.

Of the twelve candidate methane recovery projects evaluated, eight have sufficient information for a fair ranking. Three of the other four had concepts which did not offer any features not found in the eight ranked projects. The four projects recommended for further pursuit were selected by TRW on the basis of potential technology gains, economics, transferability of generated data, and on the potential for evolving widely used concepts. The selected projects are: (1) Occidental Research/Island Creek Coal - horizontal boreholes in advance of mining, (2) Bethlehem Mines - vertical wells in advance of mining, (3) Waynesburg College - multiple completion technology project, and (4) Pennsylvania Energy Resources - multiple completion, multiple wells in anthracite. The major features of these projects are described.

42246 (FE—8877-1) **Demonstration of roof mounted flexible conveyor train. Final technical report as of 28 August 1978. Volume I.** Dolecki, M.J. (Joy Mfg. Co., Franklin, PA (USA)). Apr 1978. Contract ET-75-C-01-8877. 126p. Dep. NTIS, PC A07/MF A01.

This document describes the development and demonstration of a continuous face haulage system. A laterally flexible, monorail-mounted, flexible conveyor train (FCT) was fabricated and installed underground at Laurel Run Mine in Mt. Storm, West Virginia. The 400-foot bendable belt conveyor in conjunction with a 30-foot bridge conveyor was interfaced between a continuous miner and the section panel belt for use in a three entry longwall development section. The system operated for approximately ten months until the mine strike of December 1977. Mine conditions deteriorated from the outset of the demonstration limiting total system operating time to 200 hours. Production and downtime data acquired during the demonstration indicate the continuous haulage system was never utilized to its full potential during the underground demonstration. Average shift production during the underground operation was a low 125 tons/shift of raw coal.

42247 (FE—9095-1) **Application of high volume earthmoving methods to the reclamation of area mined spoil banks. Final report.** Howland, J.W. (Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS (USA)). Feb 1978. Contract ET-75-C-01-9095. 114p. Dep. NTIS, PC A06/MF A01.

This study was conducted to make a limited field test evaluation of experimental and standard tractor dozer blades in land reclamation service. All tests were conducted on area-mined spoil banks in southeast Kansas. Generally speaking, these banks were parallel and geometrically uniform, with crest to crest distances ranging from 90 to 120 ft. Although dozing distances in the final stages of land shaping often reach 200 ft and more, the weighted average horizontal relocation distance required to level and shape normal area-mined spoil banks of this type is usually less than 50 ft. The experimental blades tested and evaluated were designed to improve dirt handling efficiency in this short distance relocation range. Earthmoving tools and systems evaluated include (1) 40-ft angle blade with 40-degree fixed angle of blade attack mounted on a Cat D9H tractor with tow assist provided by a Cat D9G, (2) 24-ft Vee Plow with 40-degree fixed angle of blade attack mounted on a Cat D9G tractor with tow assist provided by a Cat D8 tractor, (3) 24-ft grading bar mounted on a Cat D8H tractor designed to smooth rough graded land following the land shaping process, (4) 48-ft angle blade with 46-degree fixed angle of blade attack mounted on side-by-side Cat D9H tractors in an offset position, (5) 60-ft variable angle blade (40° to 75°) mounted on two Fiat-Allis 41B tractors, (6) Narrow (13 ft) deep U conventional type bulldozer blade mounted on a Cat D9H tractor, (7) Polymer injection to reduce soil-steel coefficient of friction in angle blade service. A total of 4,805,779 hp-hrs of tractor time was expended under the test program and 1.431 acres of spoil reshaped to gently rolling terrain conditions suitable for farming. Average cost on an overall basis was $671/acre for the earthmoving phase of the reclamation effort, which is approximately half normal industry costs for a comparable work effort using conventional bulldozers.

42248 (FE—9105-1(Vol.1)) **Mine entry system: longwall top slicing of thick coal seams. Design and evaluation. Final report. Volume 1.** Ellison, R.D.; Dunham, R.F.; Shaw, D.E. (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Extraction). Nov 1977. Contract ET-76-C-01-9105. 294p. Dep. NTIS, PC A13/MF A01.

Conceptual designs of entry systems for mining thick coal seams by the longwall top-slicing method were investigated. Based on a 100-foot thick seam, covering four square miles and dipping at 10 degrees, an entry concept was designed using ten slices and present-day equipment. Using five main entries driven downdip and located in rock beneath a central barrier pillar on the property centerline, the design utilizes four longwall units at full production for a rate of 2.62 million tons per year. Laterals and inclines are driven off the mains to serve single entry panels in each slice. Face lengths are typically 570 feet in length and panels are staggered to provide a smooth subsidence contour. An all-retreat layout is used with longwall operations retreating from the property boundaries to the central barrier pillar on strike. The entry concept is described in detail relative to the geometric layout, panel sequencing, production and development equipment, material handling requirements and ventilation requirements. Economic analyses indicate the method is probably not feasible at present given a required selling price of $16.33 per ton, exclusive of crushing, cleaning, and transportation

costs, for a 15 percent return on investment. However, increased demand for coal and associated higher prices will make the method feasible in the near future. Regulatory constraints on the conceptual entry system were also investigated. For the most part the design concept is in compliance with existing regulations or variances which have been granted previously. One notable exception is the absence of bleeder ventilation systems so as to minimize the leakage of air across the gob and reduce the spontaneous combustion potential.

42249 (NP—23741) **Review of the shortwall mining in the United States. Report No. 144.** Peng, S.D.; Park, D.W. (West Virginia Univ., Morgantown (USA)). Dec 1977. 15p. TIC.

During the past five years, eleven mines in the Appalachian coal field have employed the shortwall method. Just like any other mining method, shortwall is not a cure-all. It is only applicable under a set of stringent conditions. Eight of the eleven mines are satisfied with shortwall mining although there are only five mines currently operating with shortwall method. The most frequently cited advantages for which the management decided to adopt the shortwall mining method are listed. The foremost requirement for a successful shortwall mining is a moderately strong immediate roof. It should be able to self-support to some extent but caves immediately behind the gob edges of the powered supports. A successfully shortwall operation also requires a relative hard and even floor. However, a good roof and a floor cannot guarantee a high productive shortwall panel if continuous coal haulage cannot be achieved. Sliding monorail works fairly well for handling coal transportation between the head entry T-junction and the entry belt conveyor. The only obstacle remaining is a device which will provide a reliable and truly continuous face haulage.

42250 (NP—23792) **Impact of the Bureau of Mines Coal Mine Health and Safety Research Program, 1970—1977.** (Bureau of Mines, Pittsburgh, PA (USA)). Jun 1977. 115p. Bureau of Mines, Washington, DC.

With the passage of the Federal Coal Mine Health and Safety Act of 1969, Congress acted to improve the disease and injury record associated with the mining of coal. Besides mandating a strong Federal mine inspection and enforcement responsibility, the Act sets the requirements and authorizes the appropriation of funds to conduct research and development activities to eliminate hazards and/or provide alternative methods of accomplishing the required mining operations. This report highlights some of the significant products from the Bureau of Mines Coal Mine Health and Safety Research Program that are available for industrial use. Technology that has been demonstrated in the mines or is nearly ready for demonstration is also reviewed. Numerous advancements have been made in most health and safety hazard areas and many more practical techniques and devices are expected to become available within the next two years.

42251 (PB—287846) **Atlas of western surface-mined lands: coal, uranium, and phosphate.** Evans, A.K.; Uhleman, E.W.; Eby, P.A. (Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry). Jan 1978. Contract DI-14-16-0009-77-004. 396p. NTIS PC A17/MF A01.

The atlas contains available information on all coal, uranium, and phosphate surface mines in excess of 10 acres that were in operation prior to 1976 in the western 11 contiguous states plus North Dakota and South Dakota. It is assembled in a format that allows a systematic and comprehensive review of surface-mined lands so that appropriate areas can be selected for intensive biological assessment of natural and man-induced revegetation and refaunation. For each identified mine, the following information has been obtained wherever possible: geographic location and locating instructions, operator and surface and subsurface ownership, summary of the mining plan and methods, summary of the reclamation plan and methods, dates of operation, area affected by mining activities, reclamation history, where applicable, and current land use and vegetation conditions.

42252 **Low profile mining machine.** Kogelmann, W.J. US Patent 4,133,582. 9 Jan 1979. Filed date 18 Oct 1977. 10p.

To maintain the lowest possible machine profile between the bottoms of the crawler treads and the top of the turret, the boom of the machine and boom lifting cylinders are cantilevered forwardly of the turret and depressed to lie as closely as possible to the underlying gathering head of the machine without clogging the throat of the machine and/or interfering with the operation of the gathering arms. The boom pivot and boom lift cylinders are disposed ahead of the crawler treads and the connections of the boom lift cylinders with the turret are forwardly of the highest part of the gathering head. This geometry renders it possible to significantly lower the elevation of the machine turret on which the boom is mounted for sluing or swinging movement and thus minimize the total height or profile of the mining machine.

42253 **Coal technology '78. Volume 2.** Houston, TX; ICUC (1978). 474p. (CONF-781072—P2). ICUC, 6606 Bellaire Blvd., Suite 101, Houston, TX.

From Coal technology conference; Houston, TX, USA (17 Oct 1978).

The Third International Coal Utilization Convention was held October 17—19, 1978, at Houston TX. Topics covered in Volume 2 of the proceedings include: coal industry forecasting, the impact of conversion to coal (including manpower and financing), methods of selecting coal on the basis of technology and economics, differential thermal analysis of coal, coal transport, upgrading and pelletizing lignite, a few articles on gasification and liquefaction, flue gas desulfurization and particulate removal, and problems of licensing and getting permits for new sources. Twenty-one papers from Volume 2 have been entered individually into the data base. (LTN)

42254 **Preduprezhdenie endogennykh pozharov pri razrabotke krutykh ugol'nykh plastov Donbassa. (Prevention of endogenic fires during development of steep coal strata of the Don basin).** Zavitskii, G.G. Moscow, USSR; Nedra (1976). 56p.

Results are given for tests of gob flushings of crushed rock with respect to the endogenic fire hazard of spontaneously inflammable coal seams in the central region of the Don Basin. The effectiveness of gob flushing as a means of preventing endogenic fires is demonstrated. The book is intended for engineering-technical personnel of coal mines and scientific-research and design institutes. 10 references, 8 figures, 15 tables.

42255 **Blasting problem associated with strip mining.** Konya, C.J. Morgantown, WV; West Virginia Univ. (1976). 12p. (NP—23718). West Virginia Univ., Morgantown, WV.

During the past year, the coal mining industry used 1.6 billion pounds or 53 percent of all explosives sold in the United States. Approximately 94 percent of this amount represents the utilization in strip mines of explosives which were not commercially available 20 years ago. The types of explosive products used on the job are not the only changes which have occurred in blasting during the past two decades. Blasting techniques have changed, and today solutions exist for many blasting problems such as excessive backbreak, flyrock, boulders, airblast, and ground vibration. The useful energy released during a blast is of two types which could be called shock energy and gas energy. Depending on the application, one or both types of energy may be needed to accomplish the task. For secondary blasting such as mud capping boulders, shock energy is used to cause breakage. For overburden rock removal in strip mining, the gas energy in the form of a high sustained pressure is primarily used to cause the rock to break. The first decision, therefore, is which type of the energy is most beneficial for a particular job. This will suggest a family of explosives to be used. High shock energies result from high density, high velocity explosives. Low shock energy but high gas energy is available from low velocity explosives which contain large amounts of ammonium nitrate. Once the type of energy necessary is determined, other properties of the explosive such as water resistance, cost, density, fumes and priming requirements must be considered before the final selection of the explosive is made. Storage and transportation requirements can also influence the choice of an explosive.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 42154, 42171, 42173, 42175, 42180, 42181, 42188, 42253

42256 (COO—4560-1, pp 47-76) **Fundamentals of fine and ultrafine grinding in a stirred ball mill.** Herbst, J.A.; Sepulveda, J.L. Nov 1978.

In Energy requirements for the fine grinding of coal in an attritor. Final report, September 1, 1977—August 31, 1978.

Stirred ball mill grinding appears to be an effective means for grinding commercial quantities of mineral materials into the fine (below 10 μm) and ultrafine (below 1 μm) size range. This paper presents the results of a study designed to develop relationships between energy input to an attritor and the resulting product size distributions. A variety of design and operating variables are examined including attritor dimensions, stirring speed, media filling, media density, media size, pulp density and fluid viscosity. A variety of materials are examined including coal, chalcopyrite, limestone, quartz and cupric oxide. Finally, a general population balance model is proposed for attrition milling.

42257 (COO—4560-1) **Energy requirements for the fine grinding of coal in an attritor. Final report, September 1, 1977—August 31, 1978.** Herbst, J.A. (Utah Univ., Salt Lake City (USA)). Nov 1978. Contract EY-77-S-02-4560. 80p. Dep. NTIS, PC A05/MF A01.

Statistically designed experiments were carried out in a Union Process S-1 Batch Attritor involving a soft coal, Lower Freeport,

and a hard coal, Montana Rosebud, in No. 6 and No. 2 fuel oil and water slurries. Energy requirements were determined from strain gauge measurements of the torque in the attritor impeller shaft and size distribution measurements in a Model TA Coulter Counter. It was found that the energy requirements for attrition milling depended strongly on the product size, the type of coal and the viscosity of oil. The data was fitted to a Charles type energy size reduction equation to allow the prediction of energy requirements for various operating conditions. Best estimates of the energy per ton of coal required to grind in No. 2 fuel oil slurries containing between 30 and 50% solids to a product with 10 μm median size is 26 and 106 Kwh/t for Lower Freeport and Montana Rosebud, while a product with a 1 μm mass median can be produced with energy input of 1500 and 6082 Kwh/t for the soft and hard coal, respectively. An appendix was abstracted separately.

42258 (FE—9020-1) **Intermediate drive belt conveyor. Final technical report, 31 December 1978.** Jack, O.L.; Riyat, S.K. (FMC Corp., Santa Clara, CA (USA). Engineered Systems Div.). Dec 1978. Contract ET-76-C-01-9020. 168p. Dep. NTIS, PC A08/MF A01.

The objective of this project was to design, develop, and test a scale model of an intermediate drive and control system to be used on long underground coal carrying belt conveyors in both low and high coal seam applications. A program plan for the development and testing of a full-scale system was to be provided. Investigation of domestic and foreign literature and discussions with people in the industry show that conveyor belting strength is the limitation on conveyor length; intermediate drives overcome this limitation. Review of patents led to the conclusion that the friction type drive is the most practical type. A version of the auxiliary drive belt type, as used in Germany and Russia, was determined the best drive for further development. Study of control systems for multiple intermediate drives shows that the major requirement is for simultaneous starting and simultaneous stopping of all coordinated drive units. If individual control of drive speed becomes necessary, there are several methods by which this can be achieved. A scale model conveyor having one intermediate drive was fabricated and demonstrated. Testing provided design values for the coefficient of friction between belts. Cost studies show that in certain applications intermediate drives can be cost effective.

42259 (FE—11270-1) **Management of coal preparation fine wastes without disposal ponds.** Hoffman, D.C.; Briggs, R.W.; Michalski, S.R. (Dravo Corp., Pittsburgh, PA (USA)). Jan 1979. Contract AC01-79ET11270. 60p. (EPA—600/7-78-189). Dep. NTIS, PC A4/MF A01.

In the beneficiation of coal, the common medium for upgrading the mined coal is water. The end products of coal beneficiation are generaly three materials; (1) the clean coal, (2) coarsely sized waste product, and (3) a finely sized waste product. As the need for cleaner coal increases, the amount of waste products generated also increases and the importance of safe, environmentally acceptable disposal of these wastes becomes more important. Generally, the coarse refuse (plus 28 mesh) can be disposed of safely because it is a solid with inherent engineering properties that can be utilized in engineered structrues. However, the fine refuse (minus 28 mesh) generally exists as a water-based slurry devoid of significant engineering properties that can be employed in engineering disposal methods. The objective of this study is to ascertain some physical/chemical properties of a diverse sampling of fine coal refuse and to investigate the effect of chemical stabilization. Samples of fine coal refuse were obtained from some of the major coal seams in the Eastern bituminous coal fields. Two common and one proprietary chemicals were employed in testing chemical stabilization on nine samples of fine coal refuse. This study indicated that chemical stabilization can be employed to drastically improve some physical/chemiccal properties of the fine refuse for better handling and disposal. The proprietary chemical, Calcilox additive, is the most effective over the range of samples tested. Portland Type I cement is also effective but greatly influenced by waste solids concentration. The final chemical tested, lime, is inferior to the other two chemicals and generally ineffective in improving the fine waste's physical/chemical properties.

42260 (LA-UR—79-1189) **Kinetics of subbituminous coal drying.** Kashiwa, B.A.; Corlett, R.C.; Trujillo, P.E.; Elliott, G.R.B.; Vanderborgh, N.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-790630—5). Dep. NTIS, PC A02/MF A01.

From 5. underground coal conversion symposium; Alexandria, VA, USA (18 Jun 1979).

This paper explores both the effects of stress upon water removal from subbituminous coal and the consequences of drying upon underground coal conversion. Laboratory tests studying compressive stress effects on moisture transfer in the hygroscopic region are reported. Measurements of CO_2 permeability are also reported as a function of compressive stress and fluid saturation levels. Results indicate that molecular transport phenomena are unaffected by compressive stress levels while viscous transport is markedly influenced by stress. This flow decrease results from alteration of the size of larger flow channels which are necessary to support viscous fluid transport.

42261 (PB—287336) **Location studies for slurry pipelines - the effect of ground surface temperatures. Technical memo.** Coulter, D.M. (System Sciences, Inc., Bethesda, MD (USA)). 1 Jan 1976. 31p. NTIS PC A03/MF A01.

The purpose of this study was to investigate the possibility of slurry pipeline construction in locations with widely varying climatic conditions. The initial sections correlated the results of previous ground heat flux studies with the more general operational requirement studies presently underway. The heat flux varies with ground surface temperatures, and the effect on the slurry pipeline of varying ground temperature was investigated. It was found that the surface temperature of the outer side of the pipeline varied almost linearly with the ground surface temperature for given ground thermal properties. The slurry pipeline surface temperatures were found for a number of localities in the U.S. for one specific type of ground. In general for low ground surface temperatures, the surface of the pipeline could be below freezing and the possibility of water migration to a freezing boundary and even frost heaving exists under these circumstances. Means of avoiding this possibility are presented as well. Finally the effect of varying ground temperatures on the cooling requirements and cooling station spacing of the slurry are presented and are found to be relatively insignificant.

42262 **Beneficiation of lignites.** Keller, L.J. (Methacoal Corp., Dallas, TX). pp 697-708 of Coal technology '78. Volume 2. Houston, TX; ICUC (1978).

From Coal technology conference; Houston, TX, USA (17 Oct 1978).

Lignites differ significantly from most of the higher-ranked carbonaceous fuels referred to generally, as coals. This paper treats exclusively those innovative new beneficiation processes which have evolved as a part of the new field of carbonaceous resources processing, transportation, conversion, and utilization technologies now widely known as the Methacoal Technologies. The term beneficiation is treated herein in its broad sense as meaning treatments which effect improvement in quality, value, and basic nature of the end products; or which reduce the costs, the environmental impacts or the inefficiencies associated with mining, processing, transporting, storage, preparing, and utilizing the lignite resource materials. The subject beneficiation begins at the mine site, continues through processing, transportation, preparation, storage, and combustion, and ends in the stack gas cleaning operation. Efficiency of resource recovery may be improved, and unit mining costs consequently lowered. Water and inorganic gangue materials may be removed, in great part, from the mined material. Transportation may be by pipeline or in sealed-tankage haulers, isolated from the environment, and with no losses. Some, or most, of the organic sulfur may be removed from the pulverulent fuel, the amount depending on the composition of the particular lignite. Storage may be in sealed low-cost enclosures, under inert gas. Fuel may be delivered to the combustion zone as fluidized solids by pipeline. Dry combustion gases may be passed through baghouses at low temperature for particulate removal. Nahcolite or other dry chemicals may be used for final sulfur oxides reduction.

42263 **Pelletizing and drying of lignite.** Grant, A.J. (Babcock Contractors, Inc., Pittsburgh, PA); McKeever, R.E. pp 941-957 of Coal technology '78. Volume 2. Houston, TX; ICUC (1978).

From Coal technology conference; Houston, TX, USA (17 Oct 1978).

Under contract from the U.S. Department of Energy, Babcock Contractors, Inc. has completed the first phase of the development and demonstration of a lignite pelletizing process. The goal of the program is the production of a lignite agglomerate with an H.H.V. of 9500 Btu/lb and appropriate mechanical properties for transport by rail, mechanical handling, and for weather resistance. The program is designed to complement the U.S. DOE development of an ion exchange technique which would reduce lignite sodium content to 0.3%. An extensive literature survey of agglomerating techniques was conducted. Extensive pelletizing tests were carried out with a range of binders. The use of lignite char was investigated. It was determined that lignite pellets of appropriate mechanical strength and heating value could be produced. The significance of pellet moisture content and drying rate was demonstrated. Trials of lignite briquetting and extrusion were also carried out, and flowsheets, etc., for 1,200,000 tons/year plants incorporating the various process routes were developed. Simulated transport and weathering tests on lignite pellets produced encouraging results. The second phase of the program has recently commenced; this will scale up the laboratory process through successively larger pelletizing equipment and will explore the use of various lignite grinding and pellet drying techniques. Finally, a 50 ton batch of pellets will be subjected to rail

transportation, and the design and economics of a 4,000 ton/day pellet plant will be developed.

42264 Some aspects of optimization of the hydrotransport of ashes and water on the basis of laboratory tests. Dunikowski, A.; Keska, J. *Zesz. Nauk. Akad. Gorn.-Hutn. Stanislawa Staszica, Gorn.;* **535**: No. 79, 21-33(1977). (In Polish).

A method and formulas are given for the optimization of hydraulic transport. On the basis of these formulas, the best system for transporting water and ashes from the Belchatow power station is determined.

COMBUSTION

REFER ALSO TO CITATION(S) 42217, 42829, 43258, 43633, 43634, 43635, 43639

42265 (COO—4740-3) **Operation, modification, and maintenance of DOE/PETC 700 H.P. Combustion Test Facility. Quarterly activity report, October 2—December 31, 1978.** (Management and Technical Services Co., Clairton, PA (USA)). 1979. Contract EW-78-C-02-4740. 7p. Dep. NTIS, PC A02/MF A01.

Shakedown testing involved finding the maximum and minimum parameters of the boiler by varying the boiler load, fuel rate, inlet fuel temperature, steam flow, steam pressure, excess oxygen, atomizing steam to fuel pressure differential, furnace pressure, and the swirl setting. With the knowledge gained from shakedown testing, a battery of operation limit testing with No. 6 fuel oil was set up. Data gained from the operation limit testing on No. 6 fuel oil will be used in analyzing results from COM testing.

42266 (EPRI-FP—1029) **Combustion demonstration of SRC II fuel oil in a tangentially fired boiler. Final report.** Piper, B.F.; Hersh, S.; Nazimowitz, W. (KVB, Inc., Hartsdale, NY (USA)). May 1979. 109p. Dep. NTIS, PC A06/MF A01.

A combustion demonstration utilizing distillate fuel oil from the Solvent Refined, Coal II (SRC II) Process was conducted on a utility boiler located at the 74th Street Generating Station of the Consolidated Edison Company of New York. The overall program was sponsored by EPRI, the Consolidated Edison Company of New York and New York State ERDA in cooperation with the U.S. Department of Energy which supplied the SRC II fuel oil. The test boiler was a corner-fired, Combustion Engineering, Inc. unit with a rated steam flow of 450,000 lb/hr. Emissions and boiler performance were investigated at full load, half load and three-quarter load for baseline and low NOx (staged combustion) conditions. Approximately 4,500 barrels of SRC II fuel oil were utilized during the program. Measurements of nitric oxides, oxygen, carbon monoxide, polycyclic organic matter, total unburned hydrocarbons, sulfur trioxide, particulate mass and particle size distribution were obtained. The performance of SRC II fuel oil was also examined with respect to combustion characteristics and adaptation to existing boiler hardware. The No. 6 fuel oil currently burned in the test boiler was tested to compare with the SRC II fuel 1 oil. No major operational problems or adverse boiler performance effects were encountered. Nitrogen oxide emissions were nominally 70% greater than those obtained for the No. 6 fuel oil currently used by Consolidated Edison. Reductions in NOx levels on the order of 35% were demonstrated through combustion modifications with both fuels. Particulate mass emissions were lower with the SRC II fuel oil while the other emissions measured were essentially equivalent.

42267 (FE—2489-31) **Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 3, nozzle-mix burner.** Waibel, R.T.; Fleming, E.S. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1978. Contract EX-76-C-01-2489. 44p. Dep. NTIS, PC A03/MF A01.

Data were gathered to determine the performance of a nozzle-mix type burner when retrofit with low- and medium-Btu gases. The burner, a Maxon Wide-Range Model WR-4, was fired on the IGT pilot-scale test furnace with a load simulating an instant during the heat-up cycle of an annealing furnace. The low- and medium-Btu gases simulated for these combustion trials were Koppers—Totzek oxygen (KTO), Wellman—Galusha air (WGA), and Winkler air (WA) fuel gases. All three of these substitute fuel gases produced stable flames at the full rated burner input of 3.25 million Btu/hr, although, the Winkler air fuel gas flame would blow off with a small increase in excess air or a decrease in fuel heating value per cubic foot. Koppers—Totzek oxygen fuel gas performed as well as natural gas with the same thermal efficiency and even higher flame temperatures. The Wellman—Galusha and Winkler air fuel gases each exhibited lower thermal efficiencies and flame temperatures than natural gas.

42268 (PB—287521) **Combustion of hydrothermally treated coals. Final report Aug 75—Jun 77.** Stambaugh, E.P.; Giammar, R.D.; Merryman, E.L.; McNulty, J.S.; Sekhar, K.C. (Battelle Columbus Labs., OH (USA)). Apr 1978. Contract EPA-68-02-2119. 156p. NTIS PC A08/MF A01.

The report gives results of an evaluation of: (1) the relationship of the combustion characteristics of hydrothermally treated (HTT) coals to environmental emissions, boiler design, and interchangeability of solid fuels produced by the Hydrothermal Coal Process (HCP) with raw coals currently being used as the source of energy; and (2) the conversion of solubilized coal to terephthalic acid. Results indicate that the HTT coals are clean solid fuels that, in many instances, can be burned with little or no sulfur emissions. Flue gas SO2 concentrations were well below Federal Sulfur Emission Standards for New Sources. The HTT coal was found to burn as well as or better than raw coal. Trace metals emissions should be significantly reduced because of the lower concentrations in HTT coals. Therefore, the use of HTT coal in conventional boilers and furnaces should reduce environmental pollution. HTT coals appear to be more suitable for firing in wet-bottom than in dry-bottom furnaces because of potential fouling and slagging associated with their alkali content. However, additives may possibly be used to reduce fouling and slagging. The coal solubilized during desulfurization can be converted to terephthalic acid by the oxidation-Henkel reaction. However, low yields suggest that this approach may not be economical.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42158, 42275, 42848

42269 Western coal: problems, progress, and promises. Summary report. Contract EW-78-A-02-4780. Golden, CO; Colorado School of Mines Research Institute (1978). 63p. (CONF-7809140—(Summ.)). $7.00.

From Western coal-problems, progress, and promises; Keystone, CO, USA (10 Sep 1978).

The Engineering Foundation conference on Western Coal: Problems, Progress, and Promises, focused attention on the significant issues affecting the development and usage of the region's vast reserves of coal. It appeared that the main issues centered around the lack of a National energy policy, the problems associated with the Federal coal leasing program, and the regulations promulgated by the Office of Surface Mining. The transportation of western coal was the subject of a lively session involving the railroad interests on one side and the interests of pipeline enthusiasts on the other. Technical issues were not neglected but were given coverage in the following areas: emerging mining technologies, preparation, utilization options, combustion research, and particulate/SOx emissions at the power station.

HEALTH AND SAFETY

42270 (PB—287145) **The development of a methane monitor for use in electric face equipment in underground mines. Open file report.** McClatchie, E.A. (Andros, Inc., Berkeley, CA (USA)). Jul 1976. 52p. NTIS PC A04/MF A01.

A methane monitor has been designed and fabricated using a novel pressure modulated infrared absorption technique. The monitor was operated continuously during production mining for 45 days in an in-mine test; no failures occurred during the test. The monitor was regularly checked with calibration gas and no shifts in calibration were found during the test. The methane monitor met or exceeded in performance all of its target specifications. Operating principles, performance data, and electrical schematics are included in the report.

42271 (PB—287179) **Analysis for radionuclides in SRC and coal combustion samples. Final report Nov 77-Jul 78.** Koester, P.A.; Zieger, W.H. (Hittman Associates, Inc., Columbia, MD (USA)). Sep 1978. Contract EPA-68-02-2162. 33p. NTIS PC A03/MF A01.

The report deals with the determination of the levels of uranium, thorium, and their daughter products in coal, SRC, coal flyash, and SRC flyash samples taken from Georgia Power Company's Plant Mitchell during the May and June 1977 combustion tests to compare the environmental emissions from the use of coal and SRC in the boilers. Gross alpha and beta activities were also measured in the samples.

42272 Guide to modifications of safety standards in coal mines. York, P. (ed.). Washington, DC; McGraw-Hill Publications, Inc. (1979). vp. $67.00.

The federal government has set mandatory safety standards for coal mining operations since the early 1970's. The standards, set forth in Title 30 of the Code of Federal Regulations, implement the Mine Safety and Health Amendments Act. Although these standards

have the force of law, they are not absolute. The application of a standard may be impractical or pose a hazard in itself. In such cases, a mine operator may petition the federal government to modify the application of the standard, or to waive it entirely. Through mid-1978, the federal government had approved about 350 petitions for modifications and waivers. Yet, no systematic compilation was made in the past of approved alternative operating procedures and equipment. McGraw-Hill's Guide to Modifications of Safety Standards in Coal Mines is such a compilation. This guide summarizes all modifications and waivers approved between 1971 and mid-1978. It reviews the background of each modification and pertinent details of the operator's petition and of the judge's decision.

REGULATIONS

REFER ALSO TO CITATION(S) 42250

42273 (EMD—79-69) **Coal trespass in the Eastern States: more Federal oversight needed.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 25 May 1979. 56p. General Accounting Office, 441 G Street, NW, Washington, DC.

Recent public and congressional concerns have focused on the illegal mining of Federal coal in the East, specifically in Alabama. GAO's review, requested by the Chairman, Subcommittee on Energy and Power, House Committee on Interstate and Foreign Commerce, confirms that coal trespass is a serious problem. The Bureau of Land Management: has not taken aggressive and timely action to investigate coal trespass and prosecute trespassers; does not have a good grasp of Federal mineral ownership in the Eastern States to identify trespassers; and lacks "presence" and an overall plan to prevent and control trespass in the Eastern States. GAO made recommendations to improve the Bureau's oversight of Federal coal and other minerals in the Eastern States. As an alternative, the Secretary of the Interior may want to divest himself of management responsibility where scattered and isolated Federal coal tracts underlie State and private surfaces.

42274 (NP—23703) **Taxation of lignite mining in Montana and North Dakota.** Voelker, S.W.; Stinson, T.F. (Minnesota Univ., St. Paul (USA). Dept. of Agricultural and Applied Economics). Mar 1979. 14p. NTIS, PC A02/MF A01.

This paper compares taxes on lignite mining in North Dakota and Montana, using the ENERGYTAX simulation model. While severance tax payments are similar - $0.88 per ton in North Dakota compared to $0.94 to $1.07 in Montana - the total tax bill is much less in North Dakota. A model 2 million ton lignite mine, producing fuel for a mine-mouth thermogenerator, would pay State and local taxes of $1.44 per ton in Montana, but only $0.96 in North Dakota. Much of the additional tax in Montana results from including gross proceeds of the mine in the local property tax base.

42275 **Foreign investment in the U.S. mineral industry: the Case of West Virginia coal.** Labys, W.C. Morgantown, WV; West Virginia Univ. (1976). 16p. (NP—23723). West Virginia Univ., Morgantown, WV.

Some issues which must be researched in order to assess the impact of foreign investment in minerals and mineral lands include: (1) determination of the nature and extent of foreign investment, (2) measurements of the economic impact of such investment, and (3) survey of the policy areas of relevance. A case study of foreign investment in West Virginia coal provided a realistic view of the issues involved, as well as the problems encountered in collecting and analyzing data. The next stage of analysis should involve a bench mark study for the more important minerals organized on a national basis. Future monitoring of foreign investment in minerals would thus require data systems superior to those presently available. Among the more critical problems are: (1) An Early Warning system is lacking, information is made publicly available only after it appears in news sources. (2) Full information regarding the name and nationality of the financial beneficial stockholders is not available. (3) As corporate stock is sometimes held by nominees, portfolio investment can lead to investment control without detection. (4) Information regarding control parameter, such as those mentioned above are lacking, property records pertaining to land control are insufficient where deep mining and techniques are involved. (5) Details regarding alternative forms of control, such as purchases of commodity futures contracts in copper, lead, zinc, etc., are not reported. To measure the economic impact at a national level, some form of inter-industry analysis will be necessary. A comprehensive method is needed for measuring the magnitude and incidence of economic effects. Considerable further work is needed in order to arrive at a complete picture of foreign invesment in minerals and mineral lands.

PETROLEUM

42276 (DOE/EIA—0102/13) **Assessment of potential U.S. petroleum supply shortfalls, 1978—1980. Analysis memorandum.** Butler, D. (Department of Energy, Washington, DC (USA). Energy Information Administration). 15 Sep 1978. 40p. Dep. NTIS, PC A03/MF A01.

An assessment of potential U.S. petroleum supply shortfalls for the period 1978—1990 is presented. The assessment is based upon scenarios defined by the Department of Energy, International Affairs. The scenarios were constructed from two projection series specified in the 1977 Energy Information Administration (EIA) Annual Report to Congress, Volume II. The EIA projection series have been modified in this analysis to reflect the likelihood of constrained world oil supplies in the 1980's and the associated increases in oil prices required to balance world supply and demand.

42277 (DOE/EIA—0102/43) **Oil supply shortfalls resulting from a Middle East cut-off, 1978—1980. Analysis memorandum.** Kilgore, W.C.; Butler, G.D. (Department of Energy, Washington, DC (USA). Energy Information Administration). 26 Jan 1978. 15p. Dep. NTIS, PC A02/MF A01.

A forecast is presented of supply shortfalls for the major industrial countries of the world that would result from a complete cutoff of Middle East petroleum in the 1978—1980 time frame. The analysis comprises a simulation of this interruption scenario using the Petroleum Allocation (PAL) computer model. The PAL model was developed by the Energy Information Administration for the purpose of estimating future sources of petroleum imports to the United States and to calculate expected shortfalls in those imports that would result from supply interruptions. The model simulates total world trade in both crude oil and refined products and, in the case of a supply emergency, allocates available petroleum supplies among member countries of the International Energy Agency as dictated in the International Energy Program (IEP).

RESERVES

42278 (DOE/EIA—0103/31) **Reexamination of the estimation of undiscovered oil resources in the U.S.** Uri, N. (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 23p. Dep. NTIS, PC A02/MF A01.

This paper is directed at estimating total producible oil in the United States. Two specific models, a logistic model and a Gompertz model, are suggested and estimated in a fashion consistent with the theoretical considerations. The results indicate that approximately 159 billion barrels are ultimately recoverable and producible of which 117 billion barrels have been produced through the end of 1978.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 43869

42279 **Preliminary delineation of geologic trends and processes controlling petroleum accumulation in the Upper Jurassic of southwestern Alabama.** Mancini, E.A.; Stow, S.H. University, AL; University of Alabama (1977). 17p. (NP—23725).

The recent Upper Jurassic petroleum discoveries (Hatter's Pond and Chunchula Fields) in Mobile County indicate that southwestern Alabama is an important area for petroleum exploration. The geologic history of the Upper Jurassic (Smackover and Norphlet Formations) appears to be ideal for petroleum generation, migration, and entrapment. The petroleum trap in Chunchula Field is an anticline, probably resulting from salt tectonics, associated with favorable stratigraphy. The petroleum trapping mechanism in Hatter's Pond Field is a combination of extensional faulting of the Jackson fault, salt movement, and favorable stratigraphy. Additional anticlinal structures are present in southwestern Alabama to the northeast and east of the producing fields. Smackover medium-grained dolomite and Norphlet eolian sandstone are the petroleum reservoirs. The Smackover grainstones probably accumulated on shoal areas on a shallow shelf or near the shelf margin. The Smackover medium-grained dolomite grades into fine-grained dolomite to the east and northeast of the fields. The apparently more diagenetically altered carbonate reservoir in Chunchula Field is probably a result of leaching, cementation, and dolomitization of paleohighs during the time of Smackover deposition or post-depositionally. Smackover fine-grained carbonates are speculated to be the petroleum source.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 42313, 43230

42280 (ANL/ES—74) **Micellar/polymer floods for enhanced oil recovery: a review of displacement mechanisms and their simulation.** Kremesec, V.J.; Slattery, J.C. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering). Oct 1978. Contract W-31-109-ENG-38. 46p. Dep. NTIS, PC A03/MF A01.

The primary objective of this report is to serve as a background document in initiating proposals on micellar/polymer flooding of oil reservoirs. A broader objective is to suggest studies that would be part of a program emphasizing the fundamentals of flow through porous media. The report reviews and criticizes the current literature in order to explain the qualitative features of the oil displacement process and to point out those areas needing additional research. A comprehensive research program is outlined. In particular, this document is concerned with the engineering aspects of the design and prediction of micellar/polymer floods. It emphasizes the physical mechanisms of oil displacement, the parameters that govern those mechanisms, and the numerical simulation of the process. It is felt that these have not been emphasized in the nationally supported research effort to make enhanced oil recovery a viable process. 68 references, 12 figures.

42281 (BETC—4033-3) **Electrodril System Field Test Program. Phase II; Task B: deep drilling system demonstration. Final report.** (General Electric Co., Houston, TX (USA). Space Div.). Apr 1979. Contract EY-76-C-02-4033. 165p. Dep. NTIS, PC A08/MF A01.

This report documents the results of Task B on the design, procurement, fabrication assembly and test of the Electrodril Deep Drilling System. The report documents key design tradeoffs and delineates the technical approach established for development and verification test. Details of both component and subsystem testing are presented together with the results of the Systems Verification Test program. Of particular interest are the results of a 100 hour bit shaft test and the extensive test of a static inverter-motor combination. The report presents the conclusion that the Systems Verification Test of the Electrodril Deep Drilling System was successful and the recommendation that the Task C Operational Drilling Demonstration be initiated.

42282 (DOE/BC/10007—4) **Low interfacial tension and miscibility studies for surfactant tertiary oil recovery processes. Technical progress report, December 1, 1977—November 30, 1978.** Miller, C.A.; Fort, T., Jr. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). May 1979. Contract AS19-79BC10007. 25p. Dep. NTIS, PC A02/MF A01.

The polarizing microscope was used to study the structure of aqueous solutions of petroleum sulfonates in the composition range planned for injection. All the surfactants studied showed a basic pattern of transformation between one structure and another over a relatively narrow range of salinities. As the salinity where this transformation occurs increases, so does the optimum salinity with a given oil, the condition of lowest interfacial tension. A polarized light box is being developed to permit rapid determination of solution structure without the microscope since information on structure may be useful in the early stages of surfactant selection. Solutions containing a well-characterized surfactant, sodium dodecyl sulfate, were found to have the same basic structure pattern as the sulfonates. Hence, further experiments with this simple material should provide information relevant to the more complex petroleum sulfonates. The microscope was used to observe the dynamic contacting process between a surfactant solution and oil. Equilibration proceeds more rapidly at high salinities, mainly because of the spontaneous emulsification which occurs under these conditions. The ultracentrifuge was used to study microemulsions containing a conventional petroleum sulfonate. Results were similar to previous results for synthetic sulfonates except in a region where interfacial tension and solubilization results for the conventional sulfonate were anomalous. Progress was made in development of a theory to predict drop size in microemulsions, an important property influencing both phase behavior and interfacial tension. 5 figures.

42283 (LBL—8816) **Purely numerical approach for analyzing flow to a well intercepting a vertical fracture.** Narasimhan, T.N.; Palen, W.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 22p. (CONF-790460—1). Dep. NTIS, PC A02/MF A01.

From Society of Petroleum Engineers California regional meeting; Ventura, CA, USA (18 Apr 1979).

A numerical method, based on an Integral Finite Difference approach, is presented to investigate wells intercepting fractures in general and vertical fractures in particular. Such features as finite conductivity, wellbore storage, damage, and fracture deformability and its influence as permeability are easily handled. The advantage of the numerical approach is that it is based on fewer assumptions than analytic solutions and hence has greater generality. Illustrative examples are given to validate the method against known solutions. New results are presenteed to demonstrate the applicability of the method to problems not apparently considered in the literature so far.

42284 (METC/CR—79/4) **Penn Grade Micellar Displacement Project. Third annual report, June 1977—June 1978.** Danielson, H.H.; Paynter, W.T.; Ondrusek, P.S.; Finalle, L.L. (Pennzoil Co., Bradford, PA (USA)). Mar 1979. Contract EY-76-C-21-8002. 225p. Dep. NTIS, PC A10/MF A01.

During third year operations of the jointly funded Penn Grade Micellar Displacement Project, the plant facilities were completed for the 24-acre test designated Phase II. The transient testing program and the pre-flush brine and micellar slug injection stages were all completed. Biopolymer injection was initiated. This report details the development, testing, and operations of Phase II, as well as plans for continuing the test.

42285 (OCS—9) **Outer continental shelf statistics: oil, gas, sulfur, salt, leasing, drilling, production, income. 1953—1977, calendar year 1977.** Harris, W.M.; McFarlane, B.E.; Piper, S.K. (comps.). (Geological Survey, Reston, VA (USA)). Jun 1978. 101p. Geologic Survey, Mail Stop 62, Reson, VA.

Statistical data are tabulated on outer continental shelf activities from 1953 through 1977. They include production data for oil, gas, sulfur, and salt as well as information on leasing, drilling, production, and income. (JSR)

42286 (SAN—1038-PO-1) **Potential use of wood and agriculture wastes as steam generator fuel for thermal enhanced oil recovery. Final report.** Kosstrin, H.M.; McDonald, R.K. (Energy Resources Co., Inc., Cambridge, MA (USA)). Jan 1979. Contract EW-78-X-03-1038. 32p. Dep. NTIS, PC A03/MF A01.

Enhanced oil recovery by steam injection methods produces over 200,000 barrels per day of crude oil in California. A sizeable portion of the produced crude, up to 40% for some projects, may be burned to generate steam for injection into the reservoir. The purpose of this study is to evaluate the potential to use wood and agriculture wastes to replace crude oil as steam generator fuel. The Bakersfield area of California's San Joaquin Valley is the focus for this paper. Production from thermal EOR methods centers around Bakersfield and agriculture and wood wastes are available from the San Joaquin Valley and the nearby Sierra Nevada mountains. This paper documents the production of waste materials by county, estimated energy value of each material, and estimated transportation cost for each material. Both agriculture and wood wastes were found to be available in sizeable quantities and could become attractive steam generation fuels. However, some qualifications need to be made on the use of these materials. Transportation costs will probably limit the range of shipping these materials to perhaps 50 to 100 miles. Availability is subject to competition from existing and developing uses of these materials, such as energy sources in their immediate production area. Existing steam generators probably cannot be retrofitted to burn these materials. Fluidized bed combustion, or low Btu gasification, may be a good technology for utilization. FBC or FBG could accept a variety of waste materials. This will be important because the amount of any single waste may not be large enough to support the energy requirements of a good size thermal f a good size thermal EOR operation.

42287 **Process for desulfurization of residua with sodamide—hydrogen and regeneration of sodamide.** Baird, W.C. Jr.; Bearden, R. Jr.; Bollinger, R.L. Jr. (to Exxon Research and Engineering Co.). US Patent 4,123,350. 31 Oct 1978. Filed date 11 Aug 1976. 14p.

Sulfur-containing petroleum oil feedstocks which include heavy hydrocarbon constituents undergo simultaneous desulfurization and hydroconversion by contacting and reacting such feedstocks with sodamide in the presence of hydrogen and at elevated temperatures. The mixture of reaction products resulting from the above procedure is separated to give a sodium sulfur salt by-product, and a petroleum oil product which has been substantially desulfurized and demetallized, as well as being significantly improved as indicated by a reduced Conradson carbon content and an increased API gravity relative to the feedstock. Sodamide is regenerated from the sodium sulfur salt by-product and can be recycled for reaction with additional feedstock.

42288 **Process for treating wells with viscous epoxy-resin-forming solutions.** Meijs, F.H. (to Shell Oil Co.). US Patent 4,113,015. 12 Sep 1978. Priority date 30 May 1977, United Kingdom of Great Britain and Northern Ireland (UK), 8p.

A well treating process in which a granular mass is consolidated by contacting it with an epoxy resin-forming solution that precipitates a self-curing partially-cured resin, is improved by using such a solution that contains a viscosity-increasing amount of an otherwise substantially inert oil-soluble polymer.

42289 Casing perforation method and apparatus. Trott, D.E. US Patent 4,113,016. 12 Sep 1978. Filed date 26 Sep 1977. 10p.

A method and apparatus are disclosed for effecting perforation of a well casing with a casing gun while maintaining pressure in the well bore at a lower level than the pressure in the surrounding reservoir at the point of perforation. Before production tubing is run into the well, the casing gun is deposited in the bore below the desired production level. After the tubing is installed, borehole pressure is reduced to the desired level by swabbing the tubing and an automatic coupling and decoupling pickup tool is lowered on a wireline through the tubing and attached, mechanically and electrically, to the casing gun. The casing gun is then raised to the production level, as measured by locating the casing collars. When the gun is properly located, it is activated through an electrical cable carried along with the wireline. The casing gun perforates the well casing and surrounding formation, and is then decoupled from the wireline to be left in the well.

42290 Oil well testing safety valve. Barrington, B.Q.; Williamson, J.R. (to Halliburton Co.). US Patent 4,113,018. 12 Sep 1978. Filed date 30 Jun 1977. 12p.

A valve for use in conjunction with a testing string in an oil well is disclosed in which the valve is maintained in the open position until the valve is placed in sufficient compression to collapse any slip joint which also appears in the testing string. A pressure piston is present in the valve having one surface exposed to the well annulus and a second surface exposed to a pressure in a flow passage through the testing string. The valve includes a rotatable ball valve and a bypass around the ball for equalizing the pressure above the ball with the pressure below the ball for use in opening the valve from the closed position. A spring means in the valve biases the closed ball toward the open position for opening the ball when a pressure difference across the ball is reduced sufficiently to allow the ball to rotate to the open position.

42291 Hot effluent from partial oxidation of natural gas injected in oil recovery process. Hitzman, D.O. (to Phillips Petroleum Co.). US Patent 4,113,017. 12 Sep 1978. Filed date 9 Dec 1976. 6p.

Natural gas is subjected to partial oxidation with the hot effluent from the oxidation injected into an underground formation to provide hot contact fluid, solvent liquids, and drive force for recovering oil from the formation. In one embodiment liquid product, including methanol, is recovered from the hot oxidation effluent before injection of the effluent into the underground formation.

42292 Enhanced oil recovery process. Bernard, G.G.; Holm, L.W. (to Union Oil Co. of California). US Patent 4,113,011. 12 Sep 1978. Filed date 7 Mar 1977. 4p.

An enhanced oil recovery process employing an aqueous alkyl polyethylene oxide sulfate solution and a carbon dioxide displacement fluid at injection pressures above about 1,500 psi. The aqueous solution of an alkyl polyethylene oxide sulfate having 8 or 9 carbon atoms in the alkyl group and between 1 and 5 ethoxy groups significantly improves the areal sweep and overall efficiencies of dense fluid carbon dioxide enhanced oil recovery processes, especially under high salinity and low pH conditions. The efficiency of the process is increased as the injection pressure in increased.

42293 Laser drilling method and system of fossil fuel recovery. Stout, D.W. US Patent 4,113,036. 12 Sep 1978. Filed date 9 Apr 1976. 8p.

Underground bores are drilled through a formation from a plurality of vertical bore holes by use of laser beams to form a subsurface, three-dimensional bore passage pattern for in situ preparation of fossil fuel deposits to be recovered. A laser beam is projected vertically through an angularly adjusted tubular housing inserted into each bore hole from which a reflected drilling beam is laterally directed by an angularly adjusted reflector to form a bore passage.

42294 Summary of field statistics and drilling operations, Louisiana, 1977. Bates, R.D. (comp.). Baton Rouge, LA; Dept. of Natural Resources (1978). 147p. (NP—23771). Office of Conservation, Baton Rouge, LA.

418 wildcat wells were drilled which resulted in the discovery of 10 oil fields and 25 gas fields. A total of 2,538 field wells were drilled for oil and/or gas which resulted in 1,958 producing wells (excluding 105 multiple completions). For every dry field well drilled, there were 3.5 successful completions. (DLC)

PROCESSING

REFER ALSO TO CITATION(S) 42207, 42301

42295 (PB—287180) **Catalyst evaluation for denitrogenation of petroleum residue and coal liquids. Report on phase 5, Sep 75—Feb 78.** Kang, C.C.; Gendler, J. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Aug 1978. Contract EPA-68-02-0293. 57p. NTIS PC A04/MF A01.

The report covers the final phase of a study of catalysts for demetallization of heavy residual oils and for denitrogenation. Objectives were to evaluate some commercial catalysts for denitrogenation activity in petroleum residua and coal liquids, and then to develop an improved catalyst for denitrogenation of heavy coal liquids. Under one task, two commercial catalysts failed to reduce nitrogen content of a petroleum vacuum residual from 0.67% to the 0.3% target. The observed catalyst deactivation rate is similar to that of catalysts with similar pore structures which are being used for hydrodesulfurization of petroleum residual. Under another task, attempts to denitrogenate heavy coal-derived liquids with commercial Co-Mo catalysts pointed to the need for improved catalysts. In the task to improve catalysts, Ni-Mo was identified as a better active metal pair than Co-Mo or Ni-W for denitrogenation of coal liquids. Commercial preparation techniques and lower carbon deposition also increased denitrogenation activity. On the basis of catalyst weight, a bimodal pore distribution with some macropores showed better denitrogenation activity than that with micropores only. Efforts to find the optimum pore distribution were hampered by lack of technology to enlarge macropores. One experimental catalyst was tried. Denitrogenation activity did not decrease despite a low surface area.

42296 Reducing SO_2 in refinery off gas. Williamson, A.E. (to Mobil Oil Corp.). US Patent 4,123,505. 31 Oct 1978. Filed date 2 Feb 1978. 6p.

Conventionally H_2S laden gases are amine scrubbed, the H_2S sprung from the amine, converted to sulfur in the Claus process and the tail gas from the Claus process scrubbed in a tail gas facility such as Beavon—Stretford, Shell SCOT or IFP. The instant disclosure eliminates the aforementioned scrubbing processes by reducing SO_2 in Claus tail gas with a hydrogen rich gas to H_2S and condensing water out of this reduced product. The dehydrated product having a lower sulfur level is compressed and admixed with other refinery gases in a refinery fuel gas mixing vessel and used as fuel in the refinery.

42297 Hydrocarbon purification process. Chapman, C.C.; Van Pool, J. (to Phillips Petroleum Co.). US Patent 4,123,351. 31 Oct 1978. Filed date 15 Aug 1977. 8p.

In the removal of HF from hydrocarbon streams by chemical reaction with solid potassium hydroxide, run-away temperatures and subsequent explosions can occur when excess HF is present in the hydrocarbon charged to the KOH treater. According to the invention, a control system and method are provided which regulate the flow of hydrocarbon charged to the KOH treater responsive to temperature changes within the system indicative of excessive amount of HF in the hydrocarbon stream, thereby preventing the treater temperature from exceeding a preselected maximum allowable value. Several embodiments are provided whereby temperature changes in the KOH treater or a differential temperature across an HF stripper are used as temperature sensing points to control flow of hydrocarbon to the KOH treater.

42298 Hydrocracking process for the production of LPG. Hilfman, L. (to UOP Inc.). US Patent 4,121,996. 24 Oct 1978. Filed date 30 Sep 1977. 12p.

Hydrocarbons are converted with a catalyst comprising a Group VIII metal component combined with an extruded support containing alumina and mordenite. Key feature of the process involves the critical quantities of mordenite and alumina present in the composition, thereby effecting and maximizing some basic enhancement of the ability of the resultant catalyst to accelerate hydrocarbon conversion reactions theat depend on carbonium ion intermediates; i.e., the activity level of the resultant composite is markedly increased. The aforementioned critical quantities of alumina are about 15 to 40 weight percent and that of mordenite are about 85 to about 60 weight percent, wherein both are calculated on the basis of the total weight of the carrier material.

42299 Denitrification process for hydrogenated distillate oils. Miller, S.J. (to Chevron Research Co.). US Patent 4,113,607. 12 Sep 1978. Filed date 3 Mar 1977. 8p.

A process is disclosed for upgrading a hydrogenated distillate oil by extracting nitrogen compounds from the oil. In the process, these compounds are selectively extracted from the oil in a liquid—liquid extraction using as the extracting medium a solution of ferric chloride in furfural. Following intimate contacting of the oil with the extracting solution, the resulting mixture is separated into an oily raffinate phase and a solvent-extract phase. The raffinate oil is especially suitable as a feed-stock for a catalytic cracking or hydroprocessing stage employing an acidic catalyst. The extraction is carried out under moderate conditions of temperature and pressure.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 43233, 43271

42300 (CONF-7808102—, pp 13p, Paper 14) **Use of energy-efficient guidelines for refinery process units.** Lockett, W. Jr. Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Effective utilization of waste heat in petroleum-processing facilities involves three basic elements: identifying and quantifying areas of recoverable waste heat; assessing and implementing energy conservation projects; having an energy management program that measures utilization of waste heat. Exxon developed a new approach to energy management based on energy-efficient guidelines. The new system identifies where energy is being wasted. The principles incorporated in this approach may be applicable to other process industries. In discussing Exxon's experience with the energy-efficient guidelines for process units, Exxon's views on the need for energy management, how the concept was developed, application of the Energy Guideline Factor system, and Exxon's experience with the system are discussed also. (MCW)

42301 **Hydroisomerization of gasoline fraction.** Rustamov, M.I.O.; Aliev, V.S.; Abad-Zade, K.I.K.; Guseinova, A.D. US Patent 4,146,462. 27 Mar 1979. Filed date 19 May 1978. 8p.

A method is described for producing fractions of paraffin hydrocarbons of the C_4-C_7 isostructure, residing in hydroisomerization of a gasoline fraction in the presence of hydrogen on a catalyst at a temperature of 320 to 400°C, under a pressure of 20 to 60 atm, a space rate of feeding the gasoline fraction of 1.0 to 1.5 $hour^{-1}$, used as a gasoline fraction being a straight run gasoline fraction boiling out within a temperature range of 85 to 160°C or 160 to 195°C, or a gasoline fraction of the coking process, boiling out within a temperature range of 35 to 85°C or 43 to 170°C; the above catalyst comprising amorphous nickelalumosilicate and zeolite of the NaY type in the NiCaHY form, in a weight ratio of 60-9:40-10, respectively, the chemical composition of the catalyst being as follows (wt %): Ni, 7-10; Al_2O_3, 5-6; SiO_2, 86-80; Ca, 1-2; H, 1-2. The target product obtained has a high octane number, up to 89-90 according to the motor method in a pure form. The method is carried out under relatively mild conditions. It allows utilization of available, easily accessible low-octane gasoline fractions.

HEALTH AND SAFETY

42302 **Safety investigation of a major petro-chemical complex.** Farmer, F.R. (United Kingdom Atomic Energy Authority, Culcheth, England). pp XI.1.1-XI.1.13 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

An assessment of the risks of locating an oil refinery on Canvey Island is discussed.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42309

42303 (DOE/EIA—0102/53) **Role of refined product imports in the domestic fuel market.** Frederiksen, M.J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 64p. Dep. NTIS, PC A04/MF A01.

This report analyzes the effects of domestic petroleum regulations on refined product prices in the United States and on the trade-off between the levels of domestic refinery production and refined product imports. The major conclusions are that: (1) The crude oil cost advantage which domestic refiners enjoy because of crude oil price controls has decreased by 50% since March 1976. (2) At least some of the resulting increase in crude oil acquisition cost has been passed through into gasoline and distillate prices. (3) In the East Coast residual fuel oil market, imports have increased substantially since 1976, and the increase may have prevented the passthrough of crude oil cost increases. (4) The crude oil cost advantage and the small refiner bias in the entitlements program have caused greater domestic refinery production and lower utilization of foreign refining capacity than would have occurred without the regulations. (5) Deregulation of crude oil prices is likely to result in some increase in refined product prices, but full passthrough will not occur if average noncrude oil costs are lower for foreign refiners than for domestic refiners.

42304 (DOE/ERA—0039) **Availability of alternate petroleum fuels to offset natural gas curtailments for the 1978—1979 heating season (November 1—March 31).** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Dec 1978. 88p. Dep. NTIS, PC A05/MF A01.

Data on the availability of propane, middle distillates, and residual fuel oils, covering the role of these petroleum products both as primary and alternate fuels, indicate that the national supply/demand situation is favorable for the 1978—79 winter. Propane inventories, 89.9 million barrels on November 1, plus production and imports should be adequate to satisfy demand even if the 1978—79 winter is as severe as the 1976—77 winter. The inventory level of middle distillate (heating oil) at the beginning of the 1978—79 heating season is reported to be about 19% below that at the start of the 1977—78 heating season and demand for the 1978—79 heating season (based on a normal winter) is anticipated to be about 2.5 to 4% higher than that for the 1977—78 heating season, and up 5% for a colder than normal winter. The inventory level of residual fuel oil at the beginning of the 1978—79 heating season is reported to be about 15% below that at the start of the 1977—78 heating season, and demand for the 1978—79 heating season (based on a normal winter) is anticipated to be about 1.5 to 2.5% higher than that for the 1977—1978 heating season and up about 5% for a colder than normal winter

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42316

42305 (CONF-7808102—, pp 17p, Paper 13) **Selection of waste-heat-recovery equipment in petroleum refining.** Miller, R.W. (Amoco Oil Co., Chicago, IL). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Waste heat can be recovered in refining by different types of facilities. These listed in a general order of preference are: additional or optimized heat exchange surface to reduce heat loss to cooling water or air; added convective section in furnaces to reduce stack losses to atmosphere; air preheaters to reduce furnace stack losses to atmosphere;waste heat boilers to reduce furnace stack heat losses to atmosphere; and low level energy recovery. Also, waste heat generation can be reduced by controlling furnace excess air and air-in leakage. Power recovery is a separate category and is not evaluated here. After a discussion of these recovery methods, a philosophy of a waste heat recovery system is briefly evaluated. Return on investment is the criteria for capital spending, and make sure when spending money for waste heat recovery systems, the monetary risk associated with certain types of equipment should be minimized. (MCW)

42306 **Removal and preconcentration of surfactants from wastewater with open-pore polyurethane.** Smith, C.M.; Navratil, J.D. (Rockwell International, Golden, CO). *Sep. Sci. Technol.;* **14**: No. 3, 255-259(Mar 1979).

A column of in-situ polymerized open-pore polyurethane (OPP) was evaluated for removing and concentrating linear alkylate sulfonate (LAS) from synthetic wastewater. The OPP can be used to remove LAS effectively from wastewater for purification as well as a preconcentration step prior to analysis. Preliminary results of comparisons of breakthrough capacities and elution rates for LAS on OPP, active carbon, and a macroreticular resin are presented. 1 figure, 1 table.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 43245, 43246, 43732, 43738, 43758

42307 (COO—2989-T1) **Effect of Prudhoe crude oil on carbon assimilation by planktonic algae in an arctic pond.** Miller, M.C.; Hater, G.R.; Vestal, J.R. (Cincinnati Univ., OH (USA). Dept. of Biological Sciences). 1975. Contract EY-76-S-02-2989. 38p. Dep. NTIS, PC A03/MF A01.

During the summer of 1975, 240ml/m of Prudhoe crude oil was spilled on an experimental coastal pond similar to those around Prudhoe Bay. Deviaton of algal production, algal biomass and species composition was compared to an adjacent control pond. Planktonic primary productivity was initially inhibited but recovered. Algal density did not deviate in the two ponds; however, the biomass and the species composition was changed, by the elimination of the Cryptophyte Rhodomonas minuta. The time course of the effects was related to the weathering and degradation of the oil. On these ponds the effects on the phytoplankton were not significantly

different than those observed in 1970 after a controlled spill at 45 times the 1975 dose rate.

42308 (DOE/BG/01569—2) **Western Gas Sands Project. Status report, 1 December 1978—31 December 1978.** (CER Corp., Las Vegas, NV (USA)). 1978. Contract AC08-79BG01569. 92p. Dep. NTIS, PC A05/MF A01.

Objective is to increase gas production from the low-permeability gas sands of the western US. Progress on project management, resource assessment, R and D at various facilities, and field tests and demonstrations is reported in this document. (DLC)

42309 (PB—288934) **Gulf of Alaska OCS (outer continental shelf) handbook: planning for offshore oil development.** Kramer, L.S.; Clark, V.C.; Cannelos, G.J. (Alaska Dept. of Community and Regional Affairs, Juneau (USA). Div. of Community Planning). 1978. 272p. NTIS PC A12/MF A01.

The basic State policy framework within which the orderly search for offshore oil resources in the Gulf of Alaska and off Kodiak Island can proceed, is presented. This handbook also provides information about the basic operations and planning requirements of the offshore industries. The purpose of the book is to clarify the nature of outer continental shelf (OCS) oil and gas activity in the waters off Alaska and to spell out what it will mean to all Alaskans, particularly to people in coastal communities directly involved. The book sets forth the State's policies on OCS development, encouraging cooperation and coordination of effort among local governments and state agencies so that related onshore activities will confer the most benefit and the least harm.

42310 **Use of microorganisms in combination with surface active agents to synergistically disperse oil slicks.** Mohan, R.R.; Robbins, M.L.; Laskin, A.I.; Naslund, L.A. (to Exxon Research & Engineering Co.). US Patent 4,146,470. 27 Mar 1979. Filed date 22 Jul 1977. 8p.

A method of preparation and application of a composition comprising specified microorganisms in combination with surfactants for a synergistic dispersal of oil slicks is described.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 42303

42311 (DOE/EIA—0176/1) **Distributional aspects of standby gasoline rationing plan.** Peabody, G.E.; Reiser, E. (Department of Energy, Washington, DC (USA). Energy Information Administration). 12 Apr 1979. 31p. Dep. NTIS, PC A03/MF A01.

Tables show the distribution of households by the number of persons 18 years or older living in the household and the distribution of gasoline consumption less the ration amount that would be received by the households based on an allotment of 590 gallons per person. Additional tables give the net income transfer of the ration plan under the assumption that each gallon of ration allotment is worth $1.22. These tables were prepared from an existing synthetic data file that was developed with the MATH/CHRDS model.

42312 (DOE/TIC—10658) **Energy and economic impacts of alternative oil pricing policies.** (Federal Energy Administration, Washington, DC (USA)). 22 Oct 1975. 53p. Dep. NTIS, PC A04/MF A01.

A set of scenarios summarizing various polciy options of a petroleum decontrol plan are shown. The set of scenarios was chosen to allow examination of the impacts of changing one characteristic of the decontrol plan at a time. Three important characteristics were included: existence or nonexistence of import tariffs on crude oil, level of the cap price (maximum price) on domestic crude oil, and length of time until the plan is entirely phased out. Table 1 diagrammatically shows the characteristics assumed for the various cases. This table can guide the aforementioned one-characteristic-at-a-time examination. For example, the impact of moving from a $12 cap to a $10 cap can be examined by comparing options 5 and 6; the impact of a price roll-back with continuing controls can be examined by comparing options 1 and 2.

42313 (UT/CES-PS—6) **Planning for North Sea Oil: the U.K. experience.** Manners, I.R. (Texas Univ., Austin (USA). Center for Energy Studies). Dec 1978. 265p. Dep. NTIS, PC A12/MF A01.

This study was initiated with the idea that the North Sea might serve as a model for U.S. offshore development. Adversary relationships among planners, developers, regulators, and affected communities were studied. U.K. impact assessment methods and analytical procedures were reviewed with reference to their role in the policy planning process, and alternative approaches to identifying community attitudes were examined. It was found that social and environmental impact procedures are less advanced than those in the U.S. The relative lack of opposition to North Sea development is as much due to the economic and political climate and to the lack of opportunity for public involvement, as it is due to a result of effective planning mechanisms. (DLC)

PROPERTIES

42314 (AD-A—060322) **Behaviof or nonmetallic materials in shale oil derived jet fuels and in high aromatic and high sulfur petroleum fuels. Final report Jan 75-Aug 77.** Berner, W.E.; Angello, L.C. (Dayton Univ., OH (USA). Research Inst.). Jul 1978. Contract F33615-76-C-5034. 84p. NTIS PC A05/MF A01.

The increased pressure on decreasing fuel supplies has prompted the Air Force to examine fuels previously considered unacceptable. Fuels derived from shale oil and fuels in high in sulfur and mercaptan sulfur were among those considered unacceptable. The objective of this program was to evaluate nonmetallic aircraft materials relative to increased levels or aromatics, sulfur, and mercaptan sulfur. Aircraft materials that are normally in contact or exposed to fuels were evaluated in ten fuel formulations.

42315 (BETC/PPS—79/2) **Aviation turbine fuels, 1978.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). May 1979. 15p. Dep. NTIS, PC A02/MF A01.

Properties of some aviation turbine fuels marketed in the United States during 1978 are presented in this report. The samples represented are typical 1978 production and were analyzed in the laboratories of 15 manufacturers of aviation turbine (jet) fuels. Results for the properties of 90 samples of aviation turbine fuels are included in the report for military grades JP-4 and JP-5, and commercial type Jet A.

42316 (BETC/RI—79/7) **Predictive test method for coking and fouling tendency of used lubricating oil.** Steele, G.L.; Brinkman, D.W.; Whisman, M.L. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). May 1979. 16p. Dep. NTIS, PC A02/MF A01.

A short, reliable test has been developed to measure the coking and fouling tendency of used lubricating oils undergoing thermal stress. The technique utilizes commercially available instrumentation and requires only 200 mL of sample and three hours analysis time. Correlations based on oils of known quality demonstrate good qualitative predictive abilities, while reproducibility studies demonstrate quantitative reliability. It is shown that ash content alone may not always be a reliable measure of fouling potential.

42317 (PB—287707) **Analysis of sulfur in fuel oils by energy dispersive x-ray fluorescence. Final report.** Trovato, E.R.; Barron, J.W.; Slayton, J.L. (Environmental Protection Agency, Washington, DC (USA)). Jan 1978. 12p. NTIS PC A02/MF A01.

Energy dispersive x-ray fluorescence was used to analyze for sulfur in oil in commercially prepared standards, NBS standards and laboratory samples. The technique of energy dispersive x-ray fluorescence for sulfur was found to be accurate, precise, and required minimal sample preparation. In addition it was non-destructive, and enabled the simultaneous determination of sulfur and its interfering elements: phosphorus, zinc, barum, calcium, and chlorine.

42318 **Gas chromatographic determination of benzene and toluene in crude oils.** Grizzle, P.L.; Coleman, H.J. (Bartlesville Energy Tech. Center, OK). *Anal. Chem.;* **51**: No. 6, 602-608(May 1979).

A gas chromatographic method for the determination of benzene and toluene in crude oils has been developed and utilized in the analysis of 102 crude-oil samples. The method, which is readily adaptable to most chromatographs, uses a simple backflushing technique with nonpolar (OV-1) and polar (1,2,3-tris(2-cyanoethoxy)propane) columns in series. Repeatability and accuracy of the method are better than +-2% and +-4% of the measured values for benzene or toluene. The importance of such data for the identification of crude oils from a common geological origin is demonstrated. For predictive purposes, correlations of benzene and toluene weight percents with routinely measured physical properties of crude oils have been developed. Reasonable estimates of benzene and toluene concentrations can be obtained from these correlations. 4 figures, 3 tables.

STORAGE

42319 (DOE/TIC—10390) **Strategic Petroleum Reserve Plan. Amendment No. 1. Acceleration of the development schedule. Energy action No. 12.** (Federal Energy Administration, Washington, DC (USA)). [nd]. 69p. Dep. NTIS, PC A04/MF A01.

Purpose of this Amendment of Chapter VII of the SPR Plan as presented under Energy Action No. 10, is to accelerate the

development schedule to have 500 million barrels of oil in storage by the end of 1980. This document describes the proposed acceleration of the SPR and discusses the implementation activities necessary to achieve the objective. The economic and environmental impacts of the modified program are also assessed. The four sites selected for SPR crude oil storage are described.

42320 (DOE/TIC—10107) **Annual Strategic Petroleum Reserve report.** (Department of Energy, Washington, DC (USA). Office of Strategic Petroleum Reserve). 16 Feb 1979. 89p. Dep. NTIS, PC A05/MF A01.

This is the Reserve's second Annual Report, being issued in accordance with Section 165 of EPCA. This report discusses Reserve development activities during 1978. Status of the 9 sites is reported in appendixes. (DLC)

COMBUSTION

REFER ALSO TO CITATION(S) 42265

42321 (AD-A—060218) **Evaluation of future jet fuel combustion characteristics. Final report 1 Jul 75-30 Nov 76.** Blazowski, W.S.; Jackson, T.A. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH (USA)). Jul 1978. 74p. NTIS PC A04/MF A01.

Future anticipated changes in jet fuel character can be expected to have substantial combustion system effects. This report contributes technical information to assist in future definition of new jet fuel specifications formulated with the intent of minimizing total cost of system operation while maintaining performance and flight safety. The impact of lower fuel hydrogen content on combustor liner temperatures, smoke, and gaseous emissions has been evaluated and improved correlations with hydrogen content have been developed. Results obtained with the various fuel blends tested have confirmed the dominant influence of hydrogen content on combustion characteristics when compared to volatility and hydrocarbon type effects. Use of the new non-dimensional liner temperature parameter has also resulted in a good correlation of a wide variety of previous combustor data involving rich combustion systems.

NATURAL GAS

42322 **Natural gas availability - winter 1977—78.** Sampson, D.W. (New England Gas Association, Boston, MA). pp 17 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 43869

42323 (BETC/IC—79/2) **Effects of interface conductivity on electric logging in western gas sands: a literature review.** Jennings, J.B.; Carroll, H.B. Jr. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jun 1979. 26p. Dep. NTIS, PC A03/MF A01.

A review of the interface or surface conductivity literature is presented. The relationship between the electric double layer theories and interface conduction for clay and silica in formation rock is described. Current mathematical models which relate interface conductivity to rock conductivity are discussed. Suggestions for applied research which could make practical application of interface conductivity theory to logging in western gas sands are presented.

42324 (DOE/BC/10005—2) **Development of techniques for optimizing selection and completion of western tight gas sands. Phase II report, 1 January Feb 1979—28 February 1979.** Knutson, C.F.; Boardman, C.R. (CK GeoEnergy Corp., Las Vegas, NV (USA)). Feb 1979. Contract AC08-79BC10005. 51p. Dep. NTIS, PC A04/MF A01.

The Phase II work included the measurement of sandstone bed structural elements at 16 sites on Cretaceous Marine Marginal sandstone beds and at 16 sites on beds in a Lower Tertiary lacustrine sequence in eastern Utah. This work was aimed at defining the internal geometrical characteristics of these two types of reservoir rocks.

42325 (FE—5205-T1) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons: Well C-2 Lincoln County, West Virginia.** Kalyoncu, R.S.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 30 Mar 1979. Contract EY-76-C-05-5205. 104p. Dep. NTIS, PC A06/MF A01.

Mean value of hydrocarbon gases in the free space surrounding the shale is 49.3 percent of total free volume. This translates to 0.3 ft^3 of gas per ft^3 of shale. Hydrogen velues show a narrower distribution range, with amounts from 0.4 to 0.9 percent. Good correlations are found between the hydrocarbon gas values and total carbon and hydrogen contents. Increasing amounts of carbon and hydrogen are associated with higher values of hydrocarbon gas contents. Among the physical characterization data obtained are densities (bulk and true), porosity (calculated from the density data and determined with Hg-intrusion technique), surface areas, and permeabilities. Bulk densities vary between 2.55 and 2.82 g/cc with an average value of 2.68 g/cc. True density values range from 2.64 to 2.90 g/cc with an average value of 2.74 g/cc. Porosity values calculated from the density data and mercury intrusion technique are reasonably close. Mercury intrusion values vary between 2.7 to 6.1%. Very good correlations are observed between the bulk density and carbon and hydrogen contents. Higher carbon and hydrogen contents are associated with lower bulk density values indicating that major sources of carbon (and to some extent hydrogen) are organic in origin. Several shale samples analyzed using x-ray diffraction revealed that the major clay mineral phase in these shales are kaolin minerals whereas illite has been the major clay mineral phase in the majority of wells thus far studied. The absence of feldspathic and mica minerals also differentiate C-2 shales from those of other wells.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 42285, 42293, 42294

42326 (ORO—5205-T2) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons.** Kalyoncu, R.S.; Boyer, J.P.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 10 Mar 1979. Contract EY-76-C-05-5205. 448p. Dep. NTIS, PC A19/MF A01.

Total characterization data on gas contents, release kinetics, physical and chemical properties, mineralogy and lithology obtained on the C-1 well are reported. Total hydrocarbon gas contents accumulating in the free space surrounding the shale sample in the sealed canisters range from less than 10 to 90%. A positive correlation is observed between the gas contents and sample depth. Total carbon values vary between 0.4 and 7.2% with an average value of approximately 2.0% hydrogen values ranging between 0.4 and 1.0%. Carbon contents show an increase with increasing sample depth, also indicating a positive correlation between carbon and hydrocarbon gas contents. The relationship is not as pronounced between the hydrogen and gas contents. Among the physical characterization data reported are densities (true and bulk), porosities, surface area, and permeabilities. Shales exhibit relatively high bulk densities, an observation that is supported by low porosity and permeability values. A wide range of surface area values is observed. These values range between less than 1 and over 4 m^2/g. Surface area values are dominated by the clay mineral contents of the shale. Qualitatively x-ray diffraction data indicate illite to be the dominant clay mineral with occasional presence of kaolin minerals noted. Carbonate contents in these shales are very low. Among the more frequent carbonate minerals observed are nahcolite and shortite. Quartz is the most abundant single mineral. Considerable amounts of pyrite also seem to be present in a majority of the shale samples. SEM/EDAX data are in complete agreement with the XRD observations.

42327 **Process for simultaneous removal of hydrogen sulfide and water from a gas mixture without substantial removal of carbon dioxide or hydrocarbons.** Ferrin, C.R.; Manning, W.P. (to Combustion Engineering, Inc.). US Patent 4,107,270. 15 Aug 1978. Filed date 20 Jun 1977. 8p.

The process for the separation of hydrogen sulfide and water from a mixture of natural gases, which may also contain carbon dioxide, is described. Scrubbing the mixture of preheated gases with a liquid high boiling absorbent selected from the group consisting of 1-formyl piperidine and its alkylated derivatives at 250 psig absorbed both hydrogen sulfide and water but substantially less of the CO_2 and hydrocarbons. The absorbent was conducted to a desorption zone at atmospheric pressure, where it was heat regenerated and recycled into the absorption system. 2 figures.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 42341, 42342

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42336

42328 (DOE/EIA—0103/30) **Natural gas supply/demand accounting.** Everett, C.; Trapmann, W. (Department of Energy, Washington, DC (USA). Energy Information Administration). 27 Feb 1979. 28p. Dep. NTIS, PC A03/MF A01.

This paper presents a complete accounting scheme for natural gas, tracing withdrawals of natural gas from the wellhead to deliveries to final consumers. Then the utility of this methodology is exemplified through some specific applications. These applications treat data from both analytic models and publications.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 43785

42329 (UCID—18188) **Vapor generation from a 40 M^3 instantaneous LNG spill into a 100 M^2 diked soil area.** Stein, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Aug 1978. Contract W-7405-ENG-48. 6p. Dep. NTIS, PC A02/MF A01.

The vapor generation resulting from an instantaneous spill of 40 m^3 into a diked soil area is calculated. An analytical model for determining the heat transfer and vaporization has been developed. Constants in the model are determined from experiment. The diked surface area is assumed to be 10 meters by 10 meters square. 1 figure.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 43230

42330 (BETC/IC—79/3) **Review of fracture fluid-reservoir interactions in tight gas formations.** Baker, B.A.; Carroll, H.B. Jr. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jun 1979. 36p. Dep. NTIS, PC A03/MF A01.

This publication reviews the pertinent literature available on fracture fluid interactions with tight gas formations and other related subjects such as fracture proppants and reservoir characteristics. It deals primarily with the fracture fluids and their components and their effect on the rock matrix through which they flow during and after a massive hydraulic fracturing treatment. The fracture fluid components and additives include such things as the base fluids, gelling agents, gel breakers, fluid-loss additives, friction-loss reducers, pH adjusters, proppants, etc. Thus, the problem areas which have been studied in the last 10 years or so and reported in the literature are identified. Furthermore, the extent to which these problem areas have been investigated is discussed. Other related subjects covered in this publication include pore structure, fracture propagation, well testing, well performance, and reservoir analysis. 69 references.

42331 (DOE/BG/01569—1) **Western Gas Sands Project status report, 1 November 1978—30 November 1978.** (CER Corp., Las Vegas, NV (USA)). 1978. Contract AC08-79BG01569. 83p. Dep. NTIS, PC A05/MF A01.

Progress on the projects for increasing gas production from the low-permeability gas sands of the western U.S. is reported under the headings: project management, resource assessment, R and D at various DOE facilities, and field tests and demonstrations. The latter included the successful MHF treatment of the Mitchell Energy well Muse-Duke No. 1, the completion and fracturing of Zone 9 of the Mobil well PCU No. 31-13 G, and Sandia's mineback program. (DLC)

42332 (DOE/BG/01569—4) **Western Gas Sands Project status report, 1 February 1979—28 February 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BG01569. 65p. Dep. NTIS, PC A04/MF A01.

This report summarizes February, 1979 progress of the government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. Work is reported in the areas of project management, resource assessment, R and D at various laboratories, and field tests and demonstrations.

42333 (NVO—0623-1(Vol.2)) **Rio Blanco massive hydraulic fracture well RB-MHF-3. Final report.** Wendorff, C.L.; Jones, R.R. (CER Geonuclear Corp., Grand Junction, CO (USA); Dow Chemical Co., Houston, TX (USA). Dowell Div.). 29 Dec 1978. Contract EY-76-C-08-0623. 281p. (PNE-MHF—4(Vol.2)). Dep. NTIS, PC A13/MF A01.

This volume contains the following appendices: core analyses, minutes of meeting, daily drilling report, hydrocarbon and water analysis, bottomhole pressure data, daily well reports and production tabulation, pre-frac and post-frac BHP with analysis, fracture treatment preliminary design, pre-frac and fracture treatments, job logs, pressure charts, and liquid and gas analysis. (DLC)

42334 (NVO—6080-1) **Pacific Transmission Supply Company, Sand Ridge II Mesaverde massive hydraulic fracture project, Unitah County, Utah. Final report.** Beardsley, D.E.; Allen, B.W. (Pacific Transmission Supply Co., Casper, WY (USA); Almac Operating Co., Casper, WY (USA)). Sep 1978. Contract EY-76-C-08-0680. 180p. Dep. NTIS, PC A09/MF A01.

The Mesaverde Formation in the Northeast portion of the Uintah Basin is being evaluated to demonstrate the ability of the low permeability reservoirs to economically produce gas after massive hydraulic stimulation. Precontract conditions stated that stimulation would be conducted only upon confirmation of minimum reservoir conditions as determined by reservoir evaluation. The evaluation was done by a combination of drillstem testing, logging, coring, mini-fracturing to determine the in-situ stress field and fracture direction as well as the lab tests on cores. The hydraulic fracturing would be performed only if gas bearing sandstone could be shown to aggregate gas transmissibility of 0.5 millidarcy-feet in the lower Mesaverde and 1.0 millidarcy-feet in the upper zones. The test well was drilled to a total depth of 9282 feet. Production casing was run, and subsequently eight sandstone zones were perforated to test for feasibility of gas production. These zones were selected from critical analyses of drillstem tests, gas logs and open-hole logs. Although all zones showed gas production in small amounts, each zone produced water in varying amounts. Analysis of flow test data indicated that none of the zones met the minimum transmissibility requirements and therefore no massive hydraulic fracturing was performed in the Mesaverde.

42335 **Sand prop holds open record frac in E. Texas.** *Oil Gas J.;* 77: No. 1, 78-80(1 Jan 1979).

A record hydraulic fracture in the Fallon gas field in East Texas used nearly 3 million lbs of sand and more than 1 million gallons of fluid. This massive hydraulic fracture is designed to make the well produce 30-50% more gas than if fractured on a smaller scale, and 100-200% more than a conventionally completed well.

POLICY, LEGISLATION, AND REGULATION

42336 (DOE/TIC—10615) **Estimates of producer revenues and consumer costs under decontrol.** (Executive Office of the President, Washington, DC (USA). Energy Policy and Planning). 9 Jun 1977. 14p. Dep. NTIS, PC A02/MF A01.

Four cases were run to estimate the potential changes in producer revenues and consumer costs under different forms of decontrol and different gas prices. Forecasts are made for each year up to 1985. Comparisons are made with the President's plan. 10 tables. (DLC)

42337 (PB—287322) **Federal regulation of propane and naphtha: is it necessary. Report to the congress.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 24 Oct 1978. 52p. NTIS PC A04/MF A01.

This review is part of a comprehensive examination of Federal natural gas curtailment policies. The close relationship that exists between natural gas and supplemental fuels, such as propane and synthetic natural gas, requires that policies affecting these fuels be carefully considered when establishing policies for natural gas supply and demand. This report discusses the need for the Department of Energy to take required steps to exempt propane from allocation regulation but continue monitoring large users, such as natural gas utilities and transmission companies, to assure that traditional and high-priority users are not adversely affected. It also discusses the need for the Department to take the required steps to deregulate the allocation of naphtha and other synthetic natural gas feedstock supplies; however, if continued control over synthetic natural gas production is determined to be necessary, the Department should seek legislative authority to regulate the construction and operation of synthetic natural gas facilities.

TRANSPORT, PIPELINES, AND HANDLING

42338 (DOE/TIC—10303) **Decision and report to Congress on the Alaska Natural Gas Transportation System.** (Executive Office of the President, Washington, DC (USA). Energy Policy and Planning). Sep 1977. 296p. Dep. NTIS, PC A13/MF A01.

The selection of the Alcan project was made after an exhaustive review required by the Alaska Natural Gas Transportation Act of 1976 determined that the Alcan Pipeline System will deliver more natural gas at less cost to a greater number of Americans than any other proposed transportation system.

42339 (DOE/TIC—10612) **Alaska natural gas transportation system. Interagency task force on safety and design issue.** (Department of Transportation, Washington, DC (USA)). 1 Jul 1977. 47p. Dep. NTIS, PC A03/MF A01.

The safety and design issues in the Alaska natural gas transportation system relate primarily to how a recommended system should be designed, constructed, and operated, and to a lesser degree, where such a system should be located. This report discusses the relative safety and design merits of the three alternatives considered in the Federal Power Commission (FPC) Recommendation to the President, May 1, 1977. (Arctic Gas, Alcan, El Paso).

42340 **Liquefaction of natural gas.** Foerg, W. (to Linde Aktiengesellschaft). US Patent 4,112,700. 12 Sep 1978. Priority date 9 Aug 1974, German, Federal Republic of (F.R. Germany), 10p.

A process is described for the liquefaction of natural gas by heat exchange, initially with a first multicomponent mixture and thereafter with a second multicomponent mixture, each of these mixtures, respectively in a closed refrigeration cycle, being compressed, at least partially liquefied, and expanded, characterized in that the first multicomponent mixture, after the partial liquefaction thereof, is subjected to a phase separation; that the thus-obtained liquid fraction, after its expansion, is at least partially evaporated in heat exchange with media to be cooled comprising the natural gas, the gaseous fraction obtained during the phase separation, and the second multicomponent mixture; and that the gaseous fraction, liquefied in heat exchange with the expanded liquid fraction, is expanded and at least partially evaporated in heat exchange with the natural gas and with the second multicomponent mixture, which latter is at least partially liquefied during this heat exchange.

PROPERTIES

REFER ALSO TO CITATION(S) 42329

COMBUSTION

42341 (UCID—18189) **Overpressure prediction.** Sutton, S.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Oct 1977. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

A series of simple calculations were performed to estimate the overpressure from LNG cloud burning. The approach taken is that of D.A. Decker, in which the energy released in a burning cloud is equivalent to a quantity of TNT. The results are compared with those of the U.S. Army's approach. 3 figures. (DLC)

42342 (UCID—18190) **LNG fireball thermal radiation.** Stein, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1977. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

A severe thermal radiation hazard exists when the LNG vapors ignite after all the LNG has vaporized, resulting in a fireball. The hazard is maximum when the vapors are mixed stoichiometrically with air before igniting. In this report, the external radiation from various size LNG spills (1, 10, 100, 1000 m^3) is calculated and plotted versus radial distance from the center of the fireball. Total integrated heat flux and maximum fireball radius is also calculated. Radiation resulting from a pool fire is calculated. 9 figures.

OIL SHALES AND TAR SANDS

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 43230

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 42346

42343 (FE—2346-38) **Energy from in situ processing of antrim oil shale. Quarterly technical progress report, October—December 1978.** Washington, L.J. Jr. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.). 19 Jan 1979. Contract EX-76-C-01-2346. 46p. Dep. NTIS, PC A03/MF A01.

Explosive fracturing activities for the hydraulic fracturing subtask were completed in the 100 series wells. Well cleanout was almost completed and permeability studies and fracture evaluation will proceed as soon as it is complete. Evidence that there is communication between these wells continues to accumulate. The third and fourth shots in the explosive underreaming series were detonated in Well Number 301. The well cavity was was increased by a factor of 2.4 compared to the original borehole volume for a 62 foot section after the third shot. The fourth shot produced more damage to the bottom section of well casing. For the chemical underreaming subtask, Well Number 201 was notched in a limestone stringer below the Antrim formation. The well was hydrofractured with water but no communication with nearby wells was observed. The data from the extraction trials on the front site have been collected and processed in the preparation of a full report of these experiments. Some of the data are summarized in this report. Analysis of product gases from the final trial showed that they had a total energy content 4.9 times the total solid fuel and gaseous fuel put into the well for ignition, thus establishing that significant quantities of Antrim shale had been affected by the operation.

SURFACE METHODS

REFER ALSO TO CITATION(S) 42232

42344 **Water purification with fragmented oil shale.** Kilburn, J.S. US Patent 4,121,662. 24 Oct 1978. Filed date 3 Jun 1977. 10p.

Impurities are removed from impure water by introducing the impure water into a fragmented permeable mass of particles containing raw oil shale. The water introduced can be water containing hydrocarbons such as water obtained from retorting oil shale or water containing suspended solids such as blowdown from a steam generator. After introducing impure water into the fragmented permeable mass, the mass of particles can be retorted. This is particularly advantageous when the introduced water contains hydrocarbons because at least part of the hydrocarbons removed from impure water can be recovered by retorting.

REFINING

REFER ALSO TO CITATION(S) 42207

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 43751, 43785

WASTE RESEARCH AND MANAGEMENT

42345 (PNL—2596) **Evaluation of land disposal and underground injection of shale oil wastewaters.** Mercer, B.W.; Campbell, A.C.; Wakamiya, W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 59p. Dep. NTIS, PC A04/MF A01.

Results indicate that the salinity of retort water, the principal wastewater generated by shale oil recovery operations, will be too high in most cases for irrigation of cover crops needed for effective stabilization by land disposal. Furthermore, large storage lagoons would be required to hold the retort water during the long winters encountered in the oil shale regions of Colorado, Wyoming and Utah. Land disposal cannot be carried out during prolonged periods of freezing weather. Additional problems which may arise with land disposal include air pollution from volatile constituents and groundwater pollution from refractory organics and dissolved salts in the retort water. Pretreatment requirements include the removal of ammonia which is present at toxic concentrations in retort water. Underground injection of retort water may be permitted in regions possessing favorable geological characteristics. It is anticipated that this method would be used as a last resort where effective or resonably priced treatment technology is not available. Regulatory restraints are expected to limit the use of underground injection for disposal of highly polluted shale oil wastewaters. Proving the confinement of injected wastes, a frequently difficult and expensive task, will be required to assure protection of drinking water resources.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42232

42346 Leaching of organic residuals from simulated in situ retorted oil shale. Amy, G.L. (Univ. of California, Berkeley); Thomas, J.F.; Hines, A.L. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 2, 125-133(1978). (CONF-780305—P5).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Based on the results of the preliminary batch experiments, it is apparent that there exists a significant potential for contamination of groundwater by organic residuals leached from in situ spent shale, particularly spent shale produced during inert gas retorting or combustion retorting employing recycle gas. This contamination may preclude certain beneficial uses of groundwater in the immediate vicinity of abandoned in situ retorts. Both the Freundlich and Langmuir equations appear to be fairly appropriate for modelling the leaching of organic material from spent shale samples produced during inert gas retorting.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 43245

RESERVES

42347 (LA—7816-PR) **Oklo-natural fission reactor program. Progress report, January 1—March 31, 1979.** Gancarz, A.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

The U—Pb chronologic portion of a comparative U—Ru U—Pb age dating study is complete. The data for the Cluff Lake Uranium Deposit indicate multiple episodes of uranium mineralization. Concentration of uranium started at 1.3 x 10^9 years ago followeed by intense pitchblende mineralization at 1.05 x 10^9 and 0.8 x 10^9 years ago. Important technical advances in Ru mass spectrometry have been made. It appears that the analytical difficulties hampering the U—Ru part of the study have been resolved. Additional analyses of Oklo uranium ore samples confirm that lead loss is diffusion controlled. Isotopic analyses of Pb in a conglomerate layer underlying the Oklo deposit indicate that this layer is a major Pb transport path and repository.

42348 Retention of transuranic and actinide elements and bismuth at the Oklo natural reactor, Gabon: application of Eh-pH diagrams. Brookins, D.G. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). *Chem. Geol.;* **23**: No. 4, 309-323(Nov 1978).

Several tons of ^{239}Pu and lesser amounts of ^{240}Pu and ^{241}Pu were produced during the 0.5 Ma lifetime of the Oklo natural reactor, Gabon, some 1.8 Ga ago. Production of Pu isotopes is evidenced by slight excesses of ^{235}U in otherwise ^{235}U-depleted U-rich zones as well as by even slighter excesses of ^{232}Th and ^{209}Bi in the same zones. The low-grade ore, unaffected by nuclear reactions, contains very little Bi and Th, and U possesses a normal isotopic composition. The ^{241}Pu-produced Bi-excess demands that ^{241}Am, ^{237}Np and other members of the ^{241}Pu decay chain must not have migrated, since loss of any member from the ^{241}Pu decay chain would prevent the Bi excesses from accumulating in the high-grade ore zones. Eh-pH diagrams for all species of importance indicate the following: Po is retained as the native metal in the Eh-pH range of interest, whereas Pu and Np are retained as PuO_2 and NpO_2, respectively. Am is probably retained as $Am(OH)_3$ or as an $(Eu,Am)_2(CO_3)_3$ species. The field of Bi_2S_3 is wide enough to prevent migration even under slightly oxidizing conditions. Collectively, these data argue for the retention of Pu, Am, Np, U, Po and Bi at Oklo and suggest that geologic sites elsewhere should be suitable for waste isolation.

42349 Eh-pH diagrams for elements from Z = 40 to Z = 52: application to the Oklo natural reactor, Gabon. Brookins, D.G. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). *Chem. Geol.;* **23**: No. 4, 325-342(Nov 1978).

Eh-pH diagrams for elements from Z = 40 (Zr) to Z = 52 (Te) have been constructed in order to comment on migration/retention of these elements at Oklo. Although data for fissiogenic amounts of some of these elements are lacking, where such data are available to agreement between predicted migration/retention based on the Eh-pH diagrams and actual measurement is excellent. Based on Eh-pH diagrams, migration (to what degree is uncertain) of Mo and Cd is predicted whereas retention of Y, Zr, Tc, Ru, Rh, Pd, Ag and Te is also predicted. An earlier report of Frejacques et al. of Tc migration is in disagreement with Eh-pH prediction, and recent (unpublished) data argue for Tc retention. In view of the agreement between prediction and observation, the possible migration of Sb and retention of In and Sn is proposed. These data again demonstrate the usefulness of Eh-pH diagrams for the Oklo fossil nuclear reactor but, more important, allow constraints to be placed on repositories for nuclear waste now under consideration.

EXPLORATION

42350 (DP-MS—79-1) **Automated electron microprobe identification of minerals in stream sediments for the national uranium resources evaluation program.** Mosley, W.C. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 8p. (CONF-790813—3). Dep. NTIS, PC A02/MF A01.

From 14. annual meeting of the Microbeam Analysis Society; San Antonio, TX, USA (13 Aug 1979).

Over 500 stream sediment particles have been analyzed. About 96% have been identified as distinct minerals. Most of the others appeared to be mixtures. Only zinc-bearing gahnite had to be analyzed further for positive identification. Monazite and zircon were the only minerals with concentrations of uranium significantly above the detection limit. The Frantz Isodynamic Magnetic Separator isolated the monazite into the 1.0 fraction. Monazite particles in anomalous sediments contained up to 3.7 wt % uranium. This uranium concentration is unusually high for monazite, which normally has about 0.5 wt % uranium, and may be the cause of the anomaly.

42351 (GJBX—52(79)) **Evaluation models of active neutron logging tools for direct uranium measurement. Final report.** Woolson, W.A.; Gritzner, M.L. (Science Applications, Inc., La Jolla, CA (USA)). Sep 1978. Contract EY-76-C-13-1664. 221p. (SAI—78-887-LJ). Dep. NTIS, PC A10/MF A01.

The work reported here represents a continuance of the earlier effort in the analytical study of neutron logging tools for uranium exploration. Effects of the sensitivity of the neutron probes to borehole environment variations were investigated and state-of-the-art Monte Carlo calculations were performed for current neutron logging tool designs. A complete data base for neutron logging tools employing neutron detectors was generated for a uranium-bearing shale matrix to complement the available data base for a sandstone matrix. A data base for the analysis of the gamma-ray return signal from neutron interactions in a sandstone matrix was produced. A study was conducted to determine the sensitivity of the neutron probes to variations in the borehole environments that were not included as parameters in the data base. The various neutron probe evaluation models that have been developed utilize some simplification in the geometry of the probe and borehole configuration. Monte Carlo calculations provided peg points for the evaluation models. A technique was developed and a data base produced to enable the analysis of neutron logging probes as a function of case thickness, source-detector separation, and logging speed. The procedure is general enough to permit the analysis of any reasonable logging tool design.

42352 (GJBX—54(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for Wichita NTMS Quadrangle, Kansas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 9 Mar 1979. Contract EY-76-C-13-1664. 203p. (K/UR—117). Dep. NTIS, PC E05/MF E05.

Field and laboratory data are presented for 741 groundwater and 765 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. Groundwater data indicate that the most promising area for potential uranium mineralization occurs in the southwestern part of the quadrangle. Units in this area are the Permian Sumner and Nippewalla Groups. The uranium concentrations are associated with high values of arsenic, vanadium, and, to a lesser degree, molybdenum and selenium. Saline indicators are also present in this area and are probably a reflection of the evaporite deposits and saline residues contained in both of these groups. Stream sediment data indicate that high uranium values occur primarily in the north central area of the quadrangle and that the uranium in this area is in a soluble form. Rocks cropping out in this area belong to the Permian Chase and Sumner Groups. Other high uranium values throughout the quadrangle are associated with a variety of heavy and/or resistate mineral assemblages.

42353 (GJBX—55(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for St. Cloud NTMS Quadrangle, Minnesota.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 16 Mar 1979. Contract EY-76-C-13-1664. 238p. (K/UR—118). Dep. NTIS, PC E06/MF E06.

Field and laboratory data are presented for 676 groundwater and 659 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Results from the groundwater samples have not delineated any areas of apparent uranium mineralization in the St. Cloud Quadrangle. High uranium values in groundwaters occur in glacial deposits of the Des Moines Lobe west of the Alexandria Moraine and appear to reflect the composition of Cretaceous units west of the quadrangle, which served as the source for much of the glacial material. Stream sediment data indicate that relatively high uranium values are associated with the Des Moines Lobe deposits in the western portion of the quadrangle. Uranium in the eastern portion of the quadrangle appears to be associated with heavy or resistate minerals, which are contained in the Wadena Lobe glacial deposits.

42354 (GJBX—57(79)) **NURE aerial gamma-ray and magnetic reconnaissance survey: Blue Ridge area, Knoxville NI 17-1 and Charlotte NI 17-2 Quadrangles. Volume I. Narrative report.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Mar 1979. Contract EY-76-C-13-1664. 126p. Dep. NTIS, PC E07/MF E07.

As part of the Department of Energy's (DOE) National Uranium Resource Evaluation (NURE) Program, LKB Resources, Inc. has performed a rotary-wing, reconnaissance high sensitivity radiometric and magnetic survey in the Blue Ridge area of Virginia, North Carolina, South Carolina, Kentucky and Tennessee. Five (5) 1:250,000 scale NTMS quadrangles (Greensboro, Winston-Salem, Johnson City, Knoxville and Charlotte) were surveyed. A total of 15,753 line miles (25,347 kilometers) of data were collected utilizing a Sikorsky S58 and S58T helicopter. Traverse lines were flown in an east-west direction at 3.0 mile (4.8 kilometer) spacing, with tie lines flown in a north-south direction at 12 mile (20 kilometer) spacing. The data were digitally recorded at 1.0 second intervals. The NaI terrestrial detectors used in this survey had a total volume of 2,154 cubic inches. The magnetometer employed was a modified ASQ-10 fluxgate system. This report covers the Knoxville and Charlotte NTMS 1:250,000 scale quadrangles. The Greensboro, Winston-Salem, and Johnson City NTMS 1:250,000 scale quadrangles are covered in a separate report. The radiometric data were normalized to 400 feet terrain clearance, and are presented in the form of computer listings on microfiche and as stacked profile plots. Profile plots are contained in Volume II of this report. A geologic interpretation of the radiometric and magnetic data is included as part of this report.

42355 (GJBX—57(79)) **Airborne gamma-ray spectrometer and magnetometer survey: Las Vegas Quadrangle (Arizona, California, Nevada), Williams Quadrangle (Arizona), Prescott Quadrangle (Arizona), and Kingman Quadrangle (Arizona, California, Nevada). Final report. Volume I.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1979. Contract EY-76-C-13-1664. 268p. Dep. NTIS, PC E15/MF E15.

A total of 23,091 line miles of gamma-ray spectrometer and magnetometer data were acquired over 2° x 1° NTMS Quadrangle areas of Kingman (Arizona, California, Nevada), Las Vegas (Arizona, California, Nevada), Prescott (Arizona), and Williams (Arizona). Radiometric count rates in general are statistically adequate, with <2.0% of the potassium and thorium count being inadequate and <3% of the uranium count rates, when the data obtained over water and those obtained over the Grand Canyon are excluded. Particularly in the Prescott map area, but also in the Williams, Kingman, and Las Vegas areas, some very high thorium count rates were observed, indicating large areas that may contain up to 100 ppM e thorium or more in outcrop. Some of these regions in the Prescott and Williams Quadrangles may eventually be of economic interest if the breeder reactor becomes a reality. The high thorium content may also be an indication of other lithophile elements in possibly economic concentrations. The possibility exists further that one of the zones of high thorium response may be used for calibration of shine through/shine around in airborne systems due to terrestrial thorium. Areas of apparent anomalous concentrations of thorium and of uranium have been outlined on the interpretation maps and are discussed. The thorium anomalies appear to be related mainly to the Precambrian gneisses and granites. The uranium anomalies are mainly found in the Quaternary/Tertiary volcanics series, the Tertiary rhyolites, the Quaternary alluvial deposits and Quaternary/Tertiary lake bed deposits. In the Las Vegas quadrangle the Tertiary Horse Spring formation is also considered a favorable environment for uranium. In some areas, where the Cambrian Tonto group was not divided on the geological map into the Tapeats sandstone, Pioche/Carrara shales and Muav formation, a subdivision was attempted based on geochemical analysis of the gamma-ray spectrometer data.

42356 (GJBX—58(79)) **Dyersburg 1° x 2° NTMS area, Kentucky, Missouri, Tennessee, and Illinois: data release. Hydrogeochemical and stream sediment reconnaissance.** Jones, P.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1979. Contract EY-76-C-13-1664. 359p. (DPST—79-146-5). Dep. NTIS, PC E07/MF E07.

Stream sediment and stream water samples were collected from small streams at 905 sites or at a nominal density of one site per 21 square kilometers (eight square miles) in rural areas. Ground water samples were collected at 1342 sites or at a nominal density of one site per 15 square kilometers (six square miles). Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 6 other elements in ground water and for uranium and 9 other elements in surface water.

42357 (GJBX—60(79)) **Hydrogeochemical and Stream Sediment Reconnaissance Program in central United States. Semiannual progress report, October 1, 1978—March 31, 1979.** Arendt, J.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 6 Apr 1979. Contract EY-76-C-13-1664. 23p. (K/UR—21(Pt.2)). Dep. NTIS, PC A02/MF A01.

Basic data reports were open filed for eight NTMS quadrangles during the reporting period: Sherman, Houston, Ardmore, Emory Peak, Presidio, Enid, Austin, and Lawton. Basic data reports, which have been prepared and are in the process of being open filed, include Wichita, St. Cloud, Ashland, and Clinton. Results indicate that the most favorable areas for the occurrence of uranium mineralization in the open filed quadrangles are as follows: (1) Austin Quadrangle - Whitsett, Catahoula, Oakville, and Fleming Formations (Tertiary). (2) Lawton Quadrangle - Hennessey and Clearfork Groups, Garber Sandstone, and Post Oak Conglomerate (Lower Permian); and El Reno Group (Upper Permian). (3) Emory Peak Quadrangle - Tertiary tuffaceous ash beds and other igneous rocks, carbonate-dominant Cretaceous strata. During the period, approximately 13,886 samples of groundwater and stream sediments were collected by the URE Project. Approximately 20,738 samples were analyzed by the URE Laboratory.

42358 (GJBX—61(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for Ashland NTMS Quadrangle, Wisconsin; Michigan; Minnesota.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 23 Mar 1979. Contract EY-76-C-13-1664. 275p. (K/UR—119). Dep. NTIS, PC E06/MF E06.

Results of a reconnaissance geochemical survey of the Ashland Quadrangle, Wisconsin; Michigan; Minnesota are reported. Field and laboratory data are presented for 312 groundwater and 383 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwater data indicate that the most promising area for potential uranium mineralization occurs along the Douglas Thrust Fault in northern Douglas County, Wisconsin. The Douglas Fault brings Fond du Lac Formation sediments in contact with Chengwatana volcanics where carbonate-rich water derived from the mafic volcanics enter the arkosic Fond du Lac Formation. Another area of interest surrounds the Bad River Indian Reservation in northern Ashland and Iron Counties. The waters here are produced from red lithic sandstone and are also associated with the Douglas Fault. Water chemistry of these waters appears similar to the waters from the Douglas County area. The stream sediment data are inconclusive because of the extensive cover of glacial deposits. A moderately favorable area is present in a strip along Lake Superior in Douglas County, where sediments are derived from arkoses of the Fond du Lac Formation.

42359 (GJBX—62(79)) **Hydrogeochemical and stream sediment reconnaissance basic data for Clinton NTMS Quadrangle, Oklahoma.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Mar 1979. Contract EY-76-C-13-1664. 250p. (K/UR—120). Dep. NTIS, PC E06/MF E06.

Field and laboratory data are presented for 699 groundwater and 667 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwater data indicate that uranium concentrations above the 85th percentile occur primarily in the middle and north central portion of the quadrangle. High values of uranium in this area appear to be associated with saline formational water and/or the dissolution of carbonates and evaporites in the Whitehorse Group and Cloud Chief Formation. Stream sediment data indicate that uranium is primarily associated with a variety of elemental suites indicative of heavy, resistate, or accessory mineral assemblages present in various geologic formations.

42360 (GJBX—63(79)) **Poplar Bluff 1° x 2° NTMS area, Missouri and Arkansas: data release.** Heffner, J.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1979.

Contract EY-76-C-13-1664. 363p. (DPST—79-146-6). Dep. NTIS, PC E07/MF E07.

Stream sediment and stream water samples were collected from small streams at 680 sites in rural areas. Ground water samples were collected at 1350 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water and surface water.

42361 (GJBX—64(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Lamar NTMS Quadrangle, Colorado, including concentrations of forty-three additional elements.** Shannon, S.S. Jr. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract EY-76-C-13-1664. 275p. (LA—7342-MS). Dep. NTIS, PC A12/MF A01.

The Los Alamos Scientific Laboratory conducted a Hydrogeochemical and Stream Sediment Reconnaissance for uranium in the Lamar National Topographic Map Series Quadrangle, Colorado. Totals of 1043 water and 734 sediment samples were collected from 1589 locations at an actual density of one sample location per 12 km^2 over a 19 400-km^2 area. Water samples were collected from wells, streams, ponds, and springs; sediment samples were collected from streams, ponds, and springs. Water samples were analyzed for uranium and 12 additional elements. The mean uranium content of all water samples from the Lamar Quadrangle is 17.63 ppB. The mean uranium content of well water samples is 19.42 ppB; this value is among the highest yet reported for the HSSR. Water samples from 21 wells contain more than 100 ppB uranium. Clusters of water samples containing more than 50 ppB uranium, the arbitrary anomaly threshold chosen for this report, are associated with the Pierre shale, Niobrara formation, Carlile shale, Greenhorn limestone, Dakota sandstone, and alluvium along the Arkansas River. Sediment samples were analyzed for uranium, thorium, and 41 other elements. The mean uranium content of all sediment samples is 7.2 ppM. Major clusters of sediment samples containing more than 21 ppM uranium, the arbitrary anomaly threshold, are limited to areas underlain by the Pierre shale. The highest uranium values and uranium/thorium ratios are associated with exposures of the upper member of the Pierre shale in the northwestern part of the quadrangle. In situ leaching of uranium might be feasible in areas in the southern half of the quadrangle where well waters have a high uranium content. The generally high uranium content for sediments associated with the upper member of the Pierre shale is an indication that intermediate-grade uranium resources might be present in this unit in the northwestern part of the quadrangle.

42362 (GJBX—66(79)(Vol.1)) **Aerial radiometric and magnetic survey: Goldfield National Topographic Map, California and Nevada.** (Geodata International, Inc., Dallas, TX (USA)). 29 Dec 1978. Contract EY-76-C-13-1664. 262p. Dep. NTIS, PC E13/MF E13.

An airborne gamma ray and total magnetic field survey was conducted during the period October 22 to November 13, 1977. The area was surveyed using large-volume radiation detectors with associated airborne electronic equipment. The Goldfield NTMS report is separated into two volumes; this volume gives the description of the program and results. Uranium and thorium mineralization occurs within the surveyed area, with the occurrences more frequent in Esmeralda County than in southern Nye, Inyo, or Mono counties.

42363 (GJBX—69(79)(Vol.1)) **Aerial radiometric and magnetic survey: Beeville/Bay City National Topographic Map, Texas Gulf Coast.** (Geodata International, Inc., Dallas, TX (USA)). 8 Jan 1979. Contract EY-76-C-13-1664. 142p. Dep. NTIS, PC E12/MF E12.

As part of the National Uranium Resource Evaluation program Geodata International, Inc. of Dallas, Texas, conducted an airborne gamma ray and total magnetic field survey of Beeville/Bay City Quadrangle of the Texas Gulf Coast area. Volume 1 gives the description of the program and results, and volume 2 gives the flight line profile data and statistical analysis results. The Beeville/Bay City Map Sheet shows Tertiary and Quaternary-aged strata which are part of the coastal plain of the Gulf Coast Geosyncline. The Cenozoic sediments overlie Mesozoic, Paleozoic, and Precambrian rocks, and have a relatively gentle homoclinal dip toward the gulf. The Quaternary and Tertiary sediments of the map sheet overlie the western flank of the Houston-East Texas Embayment, the northeastern side of the Rio Grande Embayment, and the San Marcos Arch. Recent and Pleistocene sediments crop-out in the south and east, and are more extensive in the vicinity of the structural embayments. The Pliocene-aged Goliad Formation crops-out extensively to the northwest. Miocene and Eocene strata occur in the northwestern corner of the map sheet. The uranium deposits occur in the Tertiary strata, but are most intensely mined in the Eocene strata immediately to the west of the map sheet area.

42364 (GJBX—70(79)) **Hydrogeochemical and stream sediment reconnaissance raw data report for Sandpoint NTMS quadrangle, Washington, Idaho, and Montana.** Ciminesi, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1979. Contract EY-76-C-13-1664. 121p. (UCRL—52661). PC E06/MFE06.

This report presents the preliminary results of the geochemical sampling in the Sandpoint 1° x 2° quadrangle of the National Topographic Map Series (NTMS). From July to October 1977, 1700 wet- and dry-stream sediment samples and water samples were collected from rivers and streams from the 16,800-km^2 project area. During August and September 1977, 300 ground water samples were collected from wells and springs. Laboratory and field analyses for uranium, trace metals, and other constituents are presented in hardcopy and microfiche format. The report includes full-size overlays for use with the Sandpoint NTMS 1:250,000 quadrangle. Water sites, water-sample uranium concentrations, water sample conductivity values sediment sites and sediment-sample uranium and thorium concentrations are shown on separate overlays. Histograms and cumulative frequency plots of uranium and thorium values are presented for water and sediment samples and geology, hydrology, and known uranium occurrences are described.

42365 (GJBX—72(79)) **Artillery peak orientation study, Mohave County, Arizona.** Puchlik, K.P.; Leach, D.L.; Cazes, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1979. Contract EY-76-C-13-1664. 40p. (UCRL—52675). Dep. NTIS, PC E02/MF E02.

We present the results of an orientation study of uranium concentrations in the Artillery Peak quadrangle, Arizona, a part of the Prescott 1° X 2° quadrangle of the National Topographic Map Series (NTMS). Uranium concentrations, as well as those of 25 other elements, were measured by neutron activation analysis of wet, dry, and rock samples collected throughout the region. Uranium is found in veins and disseminations in the Precambrian rocks and in carbonaceous, tuffaceous lacustrine rocks of the Tertiary Artillery Formation. Data suggest that uranium is associated with resistate mineral phases. Data also show that stream sediments samples may not be an accurate way to determine uranium concentrations in poorly exposed lacustrine deposits similar to those in the Artillery Formation. Analytical data and field measurements are presented in tabular hardcopy and fiche format; full-size overlays are included for use with the Artillery Peak NTMS Quadrangle map and show water sample sites, water-sample uranium locations, sediment sample sites, and sediment-sample total uranium concentrations.

42366 (GJBX—73(79)) **Athens, Charlotte, Greenville, and Spartanburg NTMS 1° x 2° quadrangle areas. Supplemental data release.** Ferguson, R.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1979. Contract EY-76-C-13-1664. 124p. (DPST—79-155-1). Dep. NTIS, PC A06/MF A01.

This data release presents supplemental analytical results of stream sediments. These samples were collected as part of the SRL - NURE reconnaissance in the National Topographic Map Series (NTMS) Athens, Charlotte, Greenville, and Spartanburg 1° x 2° quadrangles. Results for 19 elements (Ag, Ba, Be, Co, Cr, Cu, K, Li, Mg, Mo, Nb, Ni, P, Pb, Sn, Sr, W, Y, and Zn) are tabulated for 5068 stream sediment samples. Field data and NAA data have already been open-filed for these four quadrangles.

42367 (GJBX—78(79)) **Geology of the Birmingham, Gadsden, and Montgomery 1° x 2° NTMS Quadrangles, Alabama.** Copeland, C.W.; Beg, M.A. (Geological Survey, University, AL (USA)). Apr 1979. Contract EY-76-C-13-1664. 192p. (DP—1530). Dep. NTIS, PC A09/MF A01.

This document is a facsimile edition (with accompanying maps) of geologic reports on the Birmingham, Gadsden, and Montgomery 1° x 2° NTMS quadrangles prepared for SRL by the Geological Survey of Alabama. The purpose of these reports is to provide background geologic information to aid in the interpretation of NURE geochemical reconnaissance data. Each report includes descriptions of economic mineral localities as well as a mineral locality map and a geologic map.

42368 (UCRL—52671) **Hydrogeochemical and stream sediment reconnaissance basic data report for Williams NTMS quadrangle, Arizona.** Wagoner, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1979. Contract W-7405-ENG-48. 137p. Dep. NTIS PC E04/MF E04.

Wet and dry sediments were collected throughout the 18,500-km^{2}arid-to-semiarid region and water samples at available streams, springs, and wells. Samples were collected between August 1977 and January 1978. Results of neutron activation analyses of uranium and trace elements and other field and laboratory analyses are presented in tabular hardcopy and microfiche format. The report includes six full-size overlays for use with the Williams NTMS 1:250,000 quadrangle. Sediment samples are divided into five general groups according to the source rock from which the sediment was derived. Background uranium concentrations for the quadrangle are relatively low, ranging from 1.91 to 2.40 ppM, with the highest associated with the Precambrian igneous and metamorphic complexes of the rare-

nown

uranium occurrences are not readily identified by the stream sediment data.

MINING

REFER ALSO TO CITATION(S) 42251, 42436, 42438, 42439

42369 (NUREG/CR—0627) **Radon-222 emissions in ventilation air exhausted from underground uranium mines.** Jackson, P.O.; Perkins, R.W.; Schwendiman, L.C.; Wogman, N.A.; Glissmeyer, J.A.; Enderlin, W.I. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 63p. (PNL—2888). Dep. NTIS, PC A04/MF A01.

The ^{222}Rn concentration in exhaust air is being measured at underground uranium mines in the Grants, New Mexico area. The objectives of the work are to determine relationships between U_3O_8 production and the mine characteristics and practices relative to ^{222}Rn emission. Concentrations in the vent air from two mines ranged from 80 nCi/m³ to 3800 nCi/m³ during a month of observations. Diurnal radon emission patterns were seen for each mine which were inversely related to barometric pressure. The average diurnal emission patterns on weekends when no mining occurred were very similar to those on weekdays during active mining, indicating that the mining activities had little short-term effect on those radon emissions. The radon emission rate from each mine vent showed a correlation with the associated ventilated surface area and the cumulative tons of U_3O_8 extracted there, and a higher correlation with cumulative tons of ore extracted. Grab samples of vent air collected at 14 additional mines in the Grants area showed radon concentrations from 7 nCi/m³ to 21,000 nCi/m³. The emission rates ranged from .01 Ci to 10 Ci per vent per day. Ore production rate estimates were available for seven of the mines and, based on these rates, a tentative average radon emission rate of 4300 Ci of ^{222}Rn per Annual Fuel Requirement (AFR) of U_3O_8 from undergrounduranium mines was obtained. Aboveground sources of radon at one mine were estimated to release approximately 5% of the total from that mine. Using this estimate, a total of 4510 Ci of ^{222}Rn released per AFR is predicted from underground uranium mining operations during the active life of the mine. After mine closure, the waste piles at that mine are estimated to continue released radon at a rate of 21 Ci/yr per AFR.

FEED PROCESSING

REFER ALSO TO CITATION(S) 42436, 42439

ENRICHMENT

42370 (MLM—2599(TR)) **Evolution of processes for separating uranium isotopes in France.** Freejacques, C.; Gelee, M.; Massignon, D.; Plurien, P. (Mound Facility, Miamisburg, OH (USA)). 23 Mar 1979. Contract EY-76-C-04-0053. 17p. (CONF-770505—350(Trans)). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear power and its fuel cycles; Salzburg, Austria (2 May 1977).

The different processes (gaseous diffusion, gasous centrifugation, aerodynamic processes, chemical exchange processes, photochemical processes, and ionic and electromagnetic processes) studied in France, principally at the Atomic Energy Commission, are considered from the double point of view of the evolution of their technical and economic performance and the proliferation risks that they involve. (LK)

42371 **Separation of uranium isotopes using anion exchangers.** Seko, M.; Miyaki, T. (to Asahi Kasei Kogyo Kabushiki Kaisha). US Patent 4,112,045. 5 Sep 1978. Priority date 5 Oct 1972, Japan, 12p.

The invention relates to a process of separating or concentrating uranium-235 from a solution containing uranium-238 and uranium-235 which involves passing a solution of a reducing agent through an ion exchange material retaining uranium in the form of U(VI) complex anions. The solution of the reducing agent elutes the uranium ions and simultaneously reduces the U(VI) complex anions to U(IV) complex cations. The eluate recovered from the bottom of the column is recovered as separate fractions. $^{235}U/^{238}U$ isotopic ratio is determined by mass spectrometry. 30 claims.

GASEOUS DIFFUSION

42372 (AD-A—059988) **In situ and laboratory determinations of shear and Young's moduli for the Portsmouth, Ohio, gaseous diffusion add-on site. Final report Nov 76-Dec 77.** Curro, J.R. Jr; Marcuson, W.F. III. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Aug 1978. 102p. NTIS PC A06/MF A01.

A field geophysical investigation was performed to determine the shear and Young's moduli as a function of depth for a site near Portsmouth, Ohio. This investigation included crosshole, downhole, and surface refraction investigation technqiues. A supplementary set of laboratory resonant column tests was performed with the Drnevich resonant column device. Laboratory undisturbed specimens were excited in both the longitudinal and torsional modes to obtain both Young's and shear moduli as a function of strain. Both laboratory and field data are presented and compared.

42373 **Double-disc gate valve.** Wheatley, S.J. (to Dept. of Energy). US Patent 4,134,571. 16 Jan 1979. Filed date 3 Nov 1977. 6p.

PAT-APPL-847,999.

The invention relates to an improvement in a conventional double-disc gate valve having a vertically movable gate assembly including a wedge, spreaders slidably engaged therewith, a valve disc carried by the spreaders. When the gate assembly is lowered to a selected point in the valve casing, the valve discs are moved transversely outward to close inlet and outlet ports in the casing. The valve includes hold-down means for guiding the disc-and-spreader assemblies as they are moved transversely outward and inward. If such valves are operated at relatively high differential pressures, they sometimes jam during opening. Such jamming has been a problem for many years in gate valves used in gaseous diffusion plants for the separation of uranium isotopes. The invention is based on the finding that the above-mentioned jamming results when the outlet disc tilts about its horizontal axis in a certain way during opening of the valve. In accordance with the invention, tilting of the outlet disc is maintained at a tolerable value by providing the disc with a rigid downwardly extending member and by providing the casing with a stop for limiting inward arcuate movement of the member to a preselected value during opening of the valve.

CENTRIFUGATION

42374 (K/OA—4445) **Optimum axial flow taper in a countercurrent gas centrifuge.** Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1 Feb 1979. Contract W-7405-ENG-26. 39p. Dep. NTIS, PC A03/MF A01.

The effect of an axially varying countercurrent circulation rate in a gas centrifuge on the efficiency factors, e/sub I/, the ideality efficiency, and e/sub C/, the circulation efficiency, is investigated and compared with the case in which the countercurrent circulation rate is constant throughout the centrifuge. The optimum variation of the centrifuge parameter m, which is a measure of the countercurrent circulation rate, as a function of axial position in the centrifuge is determined. It is shown that when the countercurrent circulation rate has its optimum value at every axial position in the centrifuge, the product of the efficiency factors, e/sub I/ x e/sub C/, can exceed 81 per cent, the nominal upper limit of the value of the product of the efficiency factors for a constant countercurrent circulation rate, and can be quite close to unity. This is illustrated by numerical examples based on a centrifuge previously described in the literature.

LASER EXCITATION

REFER ALSO TO CITATION(S) 42482, 44143

42375 (SAN—0115/99-1) **Research on nonlinear infrared processes for laser isotope separation and laser development.** Rhodes, C.K.; Bischel, W.K. (SRI International, Menlo Park, CA (USA)). 15 Jan 1977. Contract EY-76-C-03-0115-099. 118p. Dep. NTIS, PC A06/MF A01.

Laser development for both laser fusion (LF) and laser isotope separation (LIS) has been examined. Major emphasis has been on four basic activities. (1) A versatile laser facility capable of addressing a large range of problems relevant to LF and LIS has been constructed and experiments have been started. (2) A study of the radiative control of molecular processes through the radiative modification of surface crossings has demonstrated that, under appropriate conditions for 10-μm radiaion, significant alterations of the Landau-Zener probability can be induced. (3) Down-conversion to 16 μm radiation through two-quantum excitation has been experimentally demonstrated at both 16 μm and 12 μm. The results show that current CO_2 laser technology is capable of generating the appropritate wavelengths at outputs greater than 10^{-3} joules per pulse in excess of 100-Hz repetition rate. (4) An examination of two-photon amplitudes in the ultraviolet region showed that such mechanisms can be generally applied to the study of photolytic processes as well as to the examination of excited state collisional properties. In certain cases these nonlinear optical methods can produce excited

state densities greater than an order of magnitude larger than that achievable by electron beam techniques. 7 figures, 7 tables.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 42411, 42440

42376 (NUREG—0547) **Effects of natural phenomena on the Babcock and Wilcox Co. Plutonium Fabrication Plant at the Parks Township site, Leechburg, Pennsylvania. Docket No. 70-364.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Mar 1979. 57p. NTIS, PC A04/MF A01.

The proposed action is to issue a renewal to the full-term Special Nuclear Material License No. SNM-414 (Docket No. 70-364) authorizing the Nuclear Material Division of the Babcock and Wilcox Company (B&W) to operate nuclear-fuel-fabrication facilities located in Leechburg, Pennsylvania. The plutonium fuel facility is presently being used to fabricate fuel for the fast test reactor under construction at the Hanford Reservation near Richland, Washington. Implicit in Sections 70.22 and 70.23 of 10CFR70 is a requirement that existing plutonium fabrication plants be examined with the objective of improving, to the extent practicable, their abilities to withstand adverse natural phenomena without loss of capability to protect the public. In accordance with these regulations, an analysis was initiated of the effects of natural phenomena on the B&W Plutonium Fabrication Plant. Following completion of the analysis, a condensation was prepared of the effects of natural phenomena on the facility.

42377 (ORNL/CSD/TM—87) **Production control in HTGR fuel rod fabrication.** Downing, D.J.; Bailey, M. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 104p. Dep. NTIS, PC A06/MF A01.

Purpose of this report was (1) to determine which techniques (Kalman Filter, weighted least squares, Shewhart control chart) are capable of detecting drift or step changes earliest in a manufacturing process, and (2) what method would work well in maintaining the manufacturing process at an acceptable level of quality? To solve part (1) simulation studies were performed for various test cases of interest. No single technique was superior in all of these cases, but the Kalman Filter appeared to be more robust to various process changes. The weighted least squares did a good job when the weight was near unity (0.9977) and failed when the weight was small (0.63). The Shewhart control chart is better for detecting step changes than for trends. Several methods wre compared to try to answer part (2). In this report the model building and forecasting was done using the methods of Box and Jenkins.

42378 (WAPD-TM—1200) **Design and installation of the operational chemistry facility in support of LWBR binary (^{233}U) fuel production. LWBR development program.** Hollis, E.D.; Simon, C.J. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). May 1979. Contract EY-76-C-11-0014. 63p. Dep. NTIS, PC A04/MF A01.

The goal of the LWBR Development Program is to develop basic technology to improve the fuel utilization of light water reactors using a ^{233}U/thorium fuel breeding system. As part of this program, accurate chemical characterizations of fuel pellets at the beginning and end of core life are necessary to determine the degree of breeding achieved. The Bettis Atomic Power Laboratory Operational Chemistry facility is designed to provide fuel pellet analyses before core operation through the use of glovebox lines and associated equipment arranged as interconnected laboratories. These laboratories use commercially available equipment adapted for maximum radiological safety on a production-line basis. This report describes the facility design and installation, assesses the design in light of operational experience, and suggests features to be considered in future facilities.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 42404, 42405, 42411, 42414, 42432, 42467, 43492, 43510, 43580

42379 (CONF-790415—35) **Nonaqueous reprocessing method for thorium-based fuels.** Bates, J.K.; Jardine, L.J.; Krumpelt, M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

A conceptual flow sheet for the pyrometallurgical reprocessing of thorium-based fuels has been presented which meets current concerns about nonproliferation and waste control. Preliminary results indicate the desired process streams, uranium/thorium and plutonium/thorium, can be obtained using actinide solubility differences in cadmium—magnesium alloys and that salt waste can be minimized by electrolyzing CaO produced during the reduction process and recycling the calcium. However, further optimization of conditions controlling the reduction rate must be achieved before the process can be used for oxide fuels.

42380 (CONF-790532—1) **Fast reactor fuel reprocessing development in the United States: an overview.** Groenier, W.S.; Burch, W.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 53p. Dep. NTIS, PC A04/MF A01.

From Fast reactor fuel reprocessing symposium; Dounreay, UK (15 May 1979).

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As a result of the reduced nuclear power demand and the growing concerns over the potential proliferation of sensitive nuclear materials, there has not been a necessity to make immediate decisions regarding near-term reprocessing and breeder reactor commercialization. Programs which formed the basic thrust of nuclear development in the early 1970's have already been adjusted: increased emphasis on problems of radioactive waste management; increased attention to nonproliferation objectives and subsequent reorientation of the overall fuel cycle and breeder programs; increased emphasis on a once-through light-water reactor technology; increased concern for a more detailed knowledge of the uranium resource base; reorientation of the uranium enrichment programs; and exploration of alternative fuel cycles (such as thorium) to minimize the use of plutonium. Nevertheless, major strategic decisions still loom over breeder commercialization, the breeder's requisite demand for reprocessing, and the future role of more proliferation-resistant nuclear technologies. The current program in the United States is organized to provide the necessary technology for the reprocessing of breeder fuels on a timetable that is consistent with the reactor development and demonstration program. Also addressed in this paper are the present day concerns of environmental protection, safety, nuclear material safeguards, and proliferation resistance. It is structured on the well-known Purex processing method but includes new efforts aimed at advanced and alternative fuels. At the present time, the program consists mainly of a generic effort that is planned to progress through an integrated equipment engineering demonstration to an eventual pilot-plant operation. Each of these facilities is viewed as a test bed for advanced and alternative processing steps to address the many significant technical and political issues. 16 figures.

42381 (CONF-790532—2) **Computational techniques used in the development of coprocessing flowsheets.** Groenier, W.S.; Mitchell, A.D.; Jubin, R.T. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 69p. Dep. NTIS, PC A04/MF A01.

From Fast reactor fuel reprocessing symposium; Dounreay, UK (15 May 1979).

The computer program SEPHIS, developed to aid in determining optimum solvent extraction conditions for the reprocessing of nuclear power reactor fuels by the Purex method, is described. The program employs a combination of approximate mathematical equilibrium expressions and a transient, stagewise-process calculational method to allow stage and product-stream concentrations to be predicted with accuracy and reliability. The possible applications to inventory control for nuclear material safeguards, nuclear criticality analysis, and process analysis and control are of special interest. The method is also applicable to other counntercurrent liquid—liquid solvent extraction processes having known chemical kinetics, that may involve multiple solutes and are performed in conventional contacting equipment.

42382 (EPRI-NP—1055) **Multi-reactor, non-equilibrium, fuel-cycle cost minimization program with applications to plutonium recycle and limited separative work. Final report.** Connolly, T.J.; Leaver, D.E.W.; Matzie, R.A. (Stanford Univ., CA (USA)). Apr 1979. 56p. Dep. NTIS, PC A04/MF A01.

A program has been developed for the calculation of fueling requirements and fuel costs of a system of pressurized water reactors. A cycle-by-cycle energy and maintenance schedule and fuel cycle unit costs must be supplied exogenously. Each burn cycle is calculated explicitly; no equilibrium assumption is made. Enriched uranium oxide and/or mixed (uranium—plutonium) oxide fuel is considered. The program yields reactivity lifetimes and fuel isotopic composition in good agreement with more elaborate, independent calculations. The CPU execution time (0.25 to 1.6 seconds per burn cycle) is short enough to permit adaptation of the PWR system model to two independent optimum-seeking computational procedures. One allocates plutonium produced within the reactor system (as well as any available from outside) among the reactors in the system to achieve minimum system fuel cost. The other computes reload batch sizes and end-of-cycle reactivities which give minimum fuel cost, subject to separative work availability constraints, if any.

The results of several sample calculations are given. 6 figures, 9 tables.

42383 (GA-A—15224) **Iodine and ruthenium volatility in thorium fuel reprocessing. Interim development report.** Wilbourn, R.G. (General Atomic Co., San Diego, CA (USA)). Jan 1979. Contract EY-76-C-03-0167-053. 34p. Dep. NTIS, PC A03/MF A01.

The behavior of iodine and ruthenium in aqueous dissolution and fuel adjustment operations during thorium fuel reprocessing was studied. The volatility of iodine was found to be ≦ 10% and ≦ 1% in the Thorex dissolution and feed adjustment steps, respectively. Data obtained to date indicate that > 96% of iodine in thorium-based fuels may be transferred to the off-gas by treatment of dissolver product solution with nitric oxide (NO) gas. The volatility of ruthenium was found to be small, ~ 0.2%, during thorium fuel dissolution and ~ 2% in the subsequent feed adjustment step. Methods for the enhancement of iodine volatility and suppression of ruthenium volatility were investigated and are discussed. 8 figures, 10 tables.

42384 (GA-A—15298) **General Atomic Reprocessing Pilot Plant: engineering-scale dissolution system description.** Yip, H.H. (General Atomic Co., San Diego, CA (USA)). Apr 1979. Contract EY-76-C-03-0167-053. 95p. Dep. NTIS, PC A05/MF A01.

In February 1978, a dissolver-centrifuge system was added to the cold reprocessing pilot plant at General Atomic Company, which completed the installation of an HTGR fuel head-end reprocessing pilot plant. This report describes the engineering-scale equipment in the pilot plant and summarizes the design features derived from development work performed in the last few years. The dissolver operating cycles for both thorium containing BISO and uranium containinng WAR fissile fuels are included. A continuous vertical centrifuge is used to clarify the resultant dissolver product solution. Process instrumentation and controls for the system reflect design philosophy suitable for remote operation.

42385 (GA-A—15315) **Consolidated Reprocessing Progam. Quarterly progress report ending February 28, 1979.** (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract EY-76-C-03-0167-053. 77p. Dep. NTIS, PC A05/MF A01.

This publication continues the quarterly series presenting results of work performed under the Consolidated Reprocessing Program at General Atomic Company. Results of work on this program prior to June 1974 were included in a quarterly series on the HTGR Base Program. The work reported includes the development of unit processes and equipment for reprocessing of High-Temperature Gas-Cooled Reactor (HTGR) fuel, the design and development of an integrated pilot line to demonstrate the head end of HTGR reprocessing using unirradiated fuel materials, and design work in support of Hot Engineering Tests (HET). Work is also described on trade-off studies concerning the required design of facilities and equipment for the large-scale recycle of HTGR fuels in order to guide the development activities for HTGR fuel recycle.

42386 (LA—7799-MS) **Uraninite leaching: literature survey.** Grisham, G.F.; Bryant, E.A.; Williams, K.E. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 45p. (ONWI/Sub—79/E511-01200-5). Dep. NTIS, PC A03/MF A01.

A literature survey was undertaken to provide background materials for a series of experiments involving the interaction of spent uranium dioxide fuel with various environments. Notes and references pertaining to the basic properties of UO_2 as produced and after reactor exposure are presented. The use of computerized literature searches is illustrated with specific topics related to leaching experiments. 57 references.

42387 (ORNL/TM—6719) **Consolidated fuel reprocessing program. Progress report, October 1—December 31, 1978.** Burch, W.D.; Feldman, M.J.; Groenier, W.S.; Vondra, B.L.; Unger, W.E. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 143p. AT.

The status of the following studies is reported: plutonium (IV) polymer reaction in aqueous solutions; plutonium reductive stripping studies; plutonium—uranium—thorium coprocessing studies; plutonium losses due to solution instability and solids formation; solvent cleanup; nitrogen compound chemistry; fission product chemistry; electrochemical methods evaluation; evaluation of alternate extractants; hot-cell development; solvent extraction; product conversion; analytical chemistry development; voloxidation; dissolution; feed preparation; off-gas processing; and engineering systems. (LK)

42388 (ORNL/TM—6800) **In-line free acid monitor for nuclear fuel reprocessing.** Strain, J.E. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 26p. AT.

An in-line free acid monitor has been designed and tested to continuously measure the excess nitric acid present in fuel reprocessing solutions. The measurement is based on the partial pressure of water and nitric acid in equilibrium with an acid solution at constant temperature. A saturated vapor is generated by passing a low velocity stream of air through a flowing stream of the acid solution to be monitored. The vapor phase is then transported at elevated temperature to a condenser where the conductivity of the condensate is measured. The acidity of the condensate is related to the free nitric acid in the original solution. When conductivity is used to measure the condensate acidity the monitor has a useful range of < 1 Molar to 10 Molar free acid. The monitor is designed to operate in high level radiation fields and is independent of undissolved solids. Its operation is only slightly affected by the solute concentration; however it will be necessary to estimate the dissolved solids within a factor of two to realize a +- 5% accuracy in free acid determination. The response time of the monitor depends upon the rate of condensate production. The prototype monitor circulating the feed acid at 0.5 liters/hour and an evaporator temperature of 74°C produced condensate at 10 ml/hour. Under these conditions the monitor produced an accurate indication of free acid change within eight minutes.The effects of variation of air flow, temperature and other condensate acidity measurements were investigated. 6 figures.

42389 **Savannah River Plant thorium processing experience.** Orth, D.A. (E. I. du Pont de Nemours and Co., Aiken, SC). *Nucl. Technol.;* **43**: No. 1, 63-74(Apr 1979).

Some experience in ^{233}U—Th processing is available from past operations at government sites and may be of interest to the current reevaluation of thorium fuel cycles. In five separate campaigns between 1964 and 1970, the Savannah River Plant processed ~ 240 tons (MT) of thorium, irradiated as aluminum-clad metal and oxide and recovered ~ 580 kg of total uranium. Satisfactory processing routes were devised for a solvent extraction plant that normally processes enriched uranium and previously was a Purex plant. In the initial campaigns, a dilute tributyl phosphate (TBP) flowsheet recovered only uranium, and thorium was sent to waste. In later campaigns, a modified Thorex solvent extraction flowsheet recovered both uranium and thorium. Satisfactory processing required specific attention to the slow dissolving rate of ThO_2, the presence of highly radioactive ^{233}Pa, solvent extraction flowsheet constraints to avoid formation of two organic phases in the thorium—TBP systems, the ingrowth of gamma-emitting daughters of ^{232}U, and ^{233}U criticality.

42390 **Applying Bayesian decision theory to assess reprocessing economic and social cost-benefits.** Heising, C.D. (Stanford Univ., CA). pp IV.3.1-IV.3.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Bayesian decision theory, combined with conventional systems analysis techniques into the discipline called decision analysis, has been applied in this work to assess economic and social cost-benefits associated with reprocessing nuclear fuel. Particular attention in this paper is given to the models which have been developed to place numerical estimates in dollar terms on the three categories of social risks that have been identified with reprocessing. These categories include: (1) health, environment, and safety, (2) diversion of fissile material, including sabotage, terrorist acts, and subnational diversion, and (3) nuclear proliferation, defined to be a diversion at the national level to obtain weapons capability. The emphasis is placed on the third category, as proliferation risk has not been treated elsewhere in a quantitative fashion; most arguments have in the main been qualitative conjectures put forth by political scientists.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 42415, 42429, 42453, 42454, 42455, 42456, 42459, 42460

42391 (CONF-790602—58) **Effects of AFR storage location on spent fuel transportation.** Joy, D.S.; Shappert, L.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

In order to assess the impact of Away-From-Reactor (AFR) siting on the spent fuel transportation system, five different sites were studied: Argonne, Oak Ridge, Savannah River, Idaho Falls, and Richland. Transportation costs, cask fleet sizes, and radiation exposures received by transportation workers and the general public were calculated for each site. Results show that the eastern three sites are best. 5 figures, 5 tables. (DLC)

42392 (DOE/ET—0028(Vol.4)) **Technology for commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 547p. Dep. NTIS, PC A23/MF A01.

A general analysis of transportation requirements for postfission radioactive wastes that are produced from the commercial light

water reactor (LWR) fuel cycle and that are assumed to require Federal custody for storage or disposal is given. Possible radioactive wastes for which transportation requirements are described include: spent fuel, solidified high-level waste, fuel residues (cladding wastes), plutonium, and non-high-level transuranic (TRU) wastes. Transportation is described for wastes generated in three fuel cycle options: once-through fuel cycle, uranium recycle only, and recycle of uranium and plutonium. The geologic considerations essential for repository selection, the nature of geologic formations that are potential repository media, the thermal criteria for waste placement in geologic repositories, and conceptual repositories in four different geologic media are described. The media are salt deposits, granite, shale, and basalt. Possible alternatives for managing retired facilities and procedures for decommissioning are reviewed. A qualitative comparison is made of wastes generated by the uranium fuel cycle and the thorium fuel cycle. This study presents data characterizing wastes from prebreeder light water breeder reactors using thorium and slightly enriched uranium-235. The prebreeder LWBRs are essentially LWRs using thorium. The operation of HTGR and LWBR cycles are conceptually designed, and wastes produced in these cycles are compared for potential differences.

42393 (GA-A—15262) **HTGR spent fuel storage study.** Burgoyne, R.M.; Holder, N.D. (General Atomic Co., San Diego, CA (USA)). Apr 1979. Contract EY-76-C-03-0167-053. 62p. Dep. NTIS, PC A04/MF A01.

This report documents a study of alternate methods of storing high-temperature gas-cooled reactor (HTGR) spent fuel. General requirements and design considerations are defined for a storage facility integral to a fuel recycle plant. Requirements for stand-alone storage are briefly considered. Three alternate water-cooled storage conceptual designs (plug well, portable well, and monolith) are considered and compared to a previous air-cooled design. A concept using portable storage wells in racks appears to be the most favorable, subject to seismic analysis and economic evaluation verification.

42394 (RHO-BWI-C—43) **Basalt waste isolation disruptive events analysis.** Lee, W.W.L.; Nair, K.; Smith, G. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Dec 1978. Contract EY-77-C-06-1030. 129p. Dep. NTIS, PC A07/MF A01.

This study is a preliminary effort in risk quantification for a basalt repository of spent nuclear fuel. No attempt has been made to perform a risk evaluaton. The hazard of undetected boreholes was analyzed. This study used both event trees and fault trees. The analysis in the current study formalizes the preconceived notion that groundwater intrusion and tectonic processes are the most important disruptive events to a repository. The shaft seal is shown to be a key link. Although shaft seal failure is not in itself a disruption-initiating event, it is a key conditional event. The lengths of the operating phase and the long-term isolation phase are critical assumptions. The number of assumptions made by the analysts is inversely proportional to the amount of data, suggesting that a full-scale risk assessment should not be completed before the selection of a site and conceptual design is completed.

42395 **Cost-benefit estimate of transporting spent nuclear fuel by special trains.** Garrick, B.J.; Kaplan, S. (Pickard, Lowe and Garrick, Inc., Irvine, CA). pp IX.3.1-IX.3.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Special trains have been advocated by the railroads as a means of reducing the risk associated with the shipment of radioactive materials. Such trains would have severe limitations on speed, passing conditions, and train size. The resulting extra cost for special trains is about $20,000/average shipment. The question to be answered is, "is this much reduction in risk, even if it could be achieved by special trains, worth the $20,000 per shipment". A probabilistic risk analysis is performed based on the appropriate combination of the results of several government studies on nuclear transportation accidents. The cargo involved is spent fuel from nuclear power plants. The number $1,000/manrem has been advanced essentially as a utility function for radiation. Based on the $1,000/manrem number the value of the possible reduction in risk is less than $2,690/shipment. This value is substantially less than the estimated extra cost of $20,000/shipment.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42403, 42848

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42383

42396 (AECL—6186) **Radioactive waste management in Canada: a bibliography of published literature.** Hawley, N.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1978. 23p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In view of the increased interest in the management of radioactive wastes, a need has been felt for a listing of Canadian publications in this field. Over one hundred AECL reports and other Canadian papers are included as well as a list of selected international conferences on the topic. 141 references.

42397 (EPRI-NP—1052) **Activity levels of transuranic nuclides in low-level solid wastes from U.S. power reactors.** Cline, J.E.; Wright, K.L.; Hollcroft, J.W.; Lapides, M.E. (Science Applications, Inc., Rockville, MD (USA)). Apr 1979. 107p. Dep. NTIS, PC A06/MF A01.

This second interim report describes results of nuclide analyses of low-level radioactive waste from operating nuclear power plants. The report presents the results of the analyses although the emphasis is on the interim interpretation of the results. Median values of transuranic and other nuclide concentrations are calculated for the principal categories of wastes from the twenty plants included in the study. These samples were collected over a period of up to three years. The median concentrations of plutonium for each waste category is considerably below ten nanocuries/gram. A correlation has been found to exist betweeen measured concentrations of plutonium and cerium. This correlation can be used to estimate plutonium concentrations indirectly through gamma-ray spectrometry.

42398 (PNL—2941) **Summary of national and international radioactive waste management programs.** Harmon, K.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 84p. Dep. NTIS, PC A05/MF A01.

This report summarizes information collected on the status of fuel cycle and waste management programs in Argentina, Australia, Austria, Belgium, Brazil, Canada, China, Denmark, Finland, France, Democratic Republic of Germany, Federal Republic of Germany, India, Iran, Italy, Japan, Mexico, the Netherlands, Pakistan, Spain, Sweden, Switzerland, United Kingdom, United States, and USSR. This compilation attempts to provide current information as of the end of January 1979.

42399 **Transuranic waste assay instrumentation: New developments and directions at the Los Alamos Scientific Laboratory.** Close, D.A.; Umbarger, C.J.; West, L.; Smith, W.J.; Cates, M.R.; Noel, B.W.; Honey, F.J.; Franks, L.A.; Pigg, J.L.; Trundle, A.S. (Univ of Calif, Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* 7: 503-514(1978).

The Los Alamos Scientific Laboratory is developing assay instrumentation for the quantitative analysis of transuranic materials found in bulk solid wastes generated by Department of Energy facilities and by the commercial nuclear power industry. This also includes wastes generated in the decontamination and decommissioning of facilities and wastes generated during burial ground exhumation. The assay instrumentation will have a detection capability for the transuranics of less than 10 nCi of activity per gram of waste whenever practicable.

42400 **Public meetings on: nuclear waste management.** *Consum. Brief. Summ.;* No. 8, 1-24(1978).

The Interagency Review Groups (IRG) on Nuclear Waste Management held three public meetings in 1978: San Francisco (July 21—22), Denver (July 24), and Boston (August 4—5). A general overview of the attitudes expressed at these meetings is given, followed by comments on the IRG's six working areas and sample testimony. Excerpts are given from the draft IRG report to the President. Additional items are also included (NRC answers, reports, other meetings, etc.) (DLC)

WASTE PROCESSING

REFER ALSO TO CITATION(S) 42433, 42434, 42435

42401 (DOE/ET—0028(Vol.1)) **Technology for commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 327p. Dep. NTIS, PC A15/MF A01.

The scope of this report is limited to technology for management of past-fission wastes produced in the commercial nuclear power light water reactor fuel cycle. Management of spent fuel (as a waste), high-level and other transuranic wastes, and gaseous wastes are characterized. Non-transuranic wastes are described, but management of these wastes, except for gaseous wastes, is excluded from

the scope of this report. Volume 1 contains the summary and the bases and background information.

42402 (DOE/ET—0028(Vol.2)) **Technology for commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 564p. Dep. NTIS, PC A24/MF A01.

Conceptual processes and facilities for treating gaseous and various transuranium (TRU) wastes produced during the past fission portion of the light water reactor fuel cycle are described in volume 2. The goal of the treatment process for TRU wastes and for long-lived radionuclides removed from the gaseous waste streams is to convert these wastes to stable products suitable for placement in geologic isolation repositories. The treatment concepts are based on available technology. They do not necessarily represent an optimum design but are representative of what could be achieved with current technology. In actual applications it is reasonable to expect that there could be some improvement over these concepts that might be reflected in either lower costs or lower environmental impacts or both. These conceptual descriptions do provide a reasonable basis for cost analysis and for development of estimates of environmental impacts. The waste treatment technologies considered here include: high-level waste solidification, packaging of fuel residue, failed equipment and noncombustible waste treatment, general trash and combustible waste treatment, degraded solvent treatment, dilute aqueous waste pretreatment, immobilization of wet and solid wastes, off-gas particle removal systems, fuel reprocessing plant dissolver off-gas treatment, process off-gas treatment, and fuel reprocessing plant atmospheric protection system.

42403 (DOE/ET—0028(Vol.5)) **Technology for commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 642p. Dep. NTIS, PC A99/MF A01.

An analysis of the complete waste management system was developed to assess the total impact of managing radioactive wastes generated over the entire lifetime of a nuclear power system. The analysis considers the treatment and disposal of all post-fission TRU, gaseous and airborne and decommissioning wastes. Each radioactive waste stream is tracked each year from its origin through treatment, storage, transport, and accumulation in a geologic repository. The reference system is based on 400 GWe of nuclear power installed in the year 2000 and produces approximately 10,000 GWe-years of electric energy. An alternative low-growth projection based on 255 GWe in the year 2000 is also considered, but for fewer cases. This system produces approximately 6400 GWe year of electric energy. Capacity additions beyond the year 2000 are not considered a part of this system. After 40 years of operation each nuclear power plant is shut down and decommissioned. Thus, the last nuclear power plant is shut down in the year 2040. The last fuel reprocessing plant is shut down in the year 2044 and dismantled in the year 2075. Thus, the system operation encompasses a 101-year period from 1975 through 2075. In addition, the decay of radioactivity in the final repositories is followed over a million year period.

42404 (ICP—1179) **Technical division quarterly progress report, July 1—September 30 1978.** Plung, D.L. (ed.). (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Jan 1979. Contract EY-76-C-07-1540. 128p. Dep. NTIS, PC A07/MF A01.

Results are reported on work done on the long-term management of ICPP high-level wastes, ICPP plant process improvement, advanced graphite fuels reprocessing, ICPP waste management development, technical support to the Waste Calcining Facility, technical support to the New Waste Calcining Facility, effluent monitoring methods evaluation and development, technical program improvement, and on other programs. Work on long-term management of high-level wastes included post-calcination treatment, actinide removal, and calcined solids retrieval and handling. Work on uranium accountability development and on the zirconium fuel recovery process was done as part of plant process improvement. Advanced graphite fuels reprocessing work included tests on the Rover dissolver sparge nozzle, sampling studies, and the development of a Rover plant decontamination plan. Evaluation of in-place methods of determining HEPA filter efficiencies and of continuous tritium monitoring techniques were conducted. Results are reported on the fluidized-bed calcination and post-treatment of commercial high-level wastes; this work includes the study of the application of microwave energy in processing high level-wastes and the study of bidentate compounds for the separation of actinides. Other results reported include work on ^{85}Kr storage development, process and storage materials testing, zeolite encapsulation, and the long-term testing of ^{85}Kr storage media. Work, including the installation and testing of a semi-volatile removal device, volatilization and plateout testing, and CO oxidation reactor modeling, was done on HTGR fuel reprocessing.

42405 (ICP—1181) **Actinide partitioning from ICPP waste: an investigation of methods to eliminate mercury interference.** Krupa, J.F.; McIsaac, L.D.; Baker, J.D.; Meikrantz, D.H.; Schroeder, N.C. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Mar 1979. Contract EY-76-C-07-1540. 25p. Dep. NTIS, PC A02/MF A01.

Mercury is used as a catalyst for aluminum fuel dissolutions and is therefore present in much of the acidic nuclear waste generated at ICPP. Actinide partitioning from ICPP wastes with the extractant dihexyl-N,N- diethylcarbamylmethylenephosphonate (DHDECMP) is promising; however, mercury is also extracted but not removed by subsequent steps in the proposed flowsheet. Parameters affecting the extraction of mercury, such as temperature, contact time, and concentrations of acid, nitrate, and (DHDECMP) were investigated. The effect of mercury loading in the extractant on actinide extraction and stripping was studied. Methods were evaluated for mercury removal from DHDECMP; these include direct electrolysis, electrolytic replacement by metals and stripping with aqueous media containing complexants or reductants. Mercury removal by complexation using a solvent wash of sodium carbonate-sodium cyanide is the method most easily adapted to our present flowsheet.

42406 (LA-UR—78-2412) **Early screening of nuclear waste retrieval and processing alternatives.** Whitty, W.J.; Cox, N.D. (Los Alamos Scientific Lab., NM (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 22p. (CONF-790455—1). Dep. NTIS, PC A02/MF A01.

From Joint national meeting of the Institute of Management Sciences and the Operations Research Society of America; New Orleans, LA, USA (30 Apr 1979).

The retrieval and processing of the buried transuranic-contaminated waste stored at the Idaho National Engineering Laboratory was studied by two task force teams. A linear additive scoring model was used for the evaluation. The figures of merit for the retrieval systems showed that one of the systems was superior to the others. (DLC)

42407 (ORNL/TM—6182) **Iodox process tests in a transuranium element production campaign.** Collins, E.D.; Benker, D.E. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 32p. AT.

The Iodox process, an advanced method for removing gaseous radioiodine from airstreams, was tested at high activity levels during transuranium element production operations. Special equipment was used to remove radioiodine from 3-5M HNO_3 dissolver solutions by volatilization and to absorb the iodine from the dissolver off-gas into hyperazeotropic HNO_3. More than 96% of the ^{131}I in the dissolver solutions was removed by heeating to 100°C and air-sparging. Treatments such as boiling, sparging with 5% N_2O_3, and adjustment to 10^{-4} M KI or 1% H_2O_2 effected the additional removal of ^{131}I by factors of 2 to 5. Other than ^{131}I, no fission products were volatilized during the treatments. A six-stage bubble-cap column was used for the abosrptttion. Off-gas decontamination factors were in the range of 1×10^4 to $8 \times 10_4$, or 5 to 7 per stage; these values are similar to those obtained during previous low-activity studies.

42408 (ORNL/TM—6607) **Literature survey of methods to remove iodine from off-gas streams using solid sorbents.** Jubin, R.T. (Oak Ridge National Lab., TN (USA)). Mar 1979. Contract W-7405-ENG-26. 88p. AT.

During the past two decades, various systems have been studied to reduce the iodine released to the environment. Two liquid systems are available: the Iodox system and the mecuric nitrate—nitric acid (Mercurex) system. Solid sorbents have also been studied, either as secondary systems to provide final filtering following use of either the Iodox or Mercurex system or as primary systems to replace the liquid methods. These solid sorbents include silver zeolite, silver mordenite, alumina silicates, and macroreticular resins. Activated carbon has also been examined as a reference material. Activated carbon, however, cannot be considered as a primary sorbent for reprocessing plant off-gas, because of its low ignition temperature and its adverse reactions with nitrogen oxide which could lead to the formation of explosive compounds and to poisoning by organic contaminant in the off-gas. The most promising system to date for primary iodine removal is the Iodox system. This system has already been tested on an engineering scale and has demonstrated good capabilities and operability. There are, however, concerns about the long-term integrity of the piping in contact with the 20 to 23 M HNO_3. Silver mordenite appears to be the most promising of the solid sorbents developed thus far. This material will, however, require additional testing with CH_3I, in addition to engineering-scale tests of filter beds and regeneration facilities. A silver-containing alumina silicate, AC-6120, also shows potential on a once-through basis. Silver zeolites are capable of adsorbing iodine up to 500°C. Silver zeolites, like most other sorbents, are adversely affected by water vapor especially when condensation occurs. The

high cost of silver and its limited regeneration potential, plus the lack of acid resistance of the zeolite, makes it less attractive than silver mordenite or AC-6120 for large-scale use.

42409 (RFP—2812) **Waste management analysis for the nuclear fuel cycle. I. Actinide recovery from aqueous salt wastes.** Martella, L.L.; Navratil, J.D. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 12 May 1979. Contract EY-76-C-04-3533. 18p. Dep. NTIS, PC A02/MF A01.

A preliminary feasibility study of solvent extraction methods has been completed for removing actinides from selected salt wastes likely to be produced during reactor fuel fabrication and reprocessing. The use of a two-step solvent extraction system, tributyl phosphate (TBP) followed by a bidentate organophosphorus extractant (DHDECMP), appears most efficient for removing actinides from salt waste. The TBP step would remove most of the plutonium and >99.99% of the uranium. The second step, using DHDECMP, would remove >99.91% of the americium, the remaining plutonium (>99.98%), and other actinides from the acidified salt waste.

42410 (RFP—2813) **Waste management analysis for the nuclear fuel cycle. II. Recycle preparation for wastewater streams.** Smith, C.M.; Navratil, J.D.; Plock, C.E. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 10 May 1979. Contract EY-76-C-04-3533. 26p. Dep. NTIS, PC A03/MF A01.

Recycle preparation methods were evaluated for secondary aqueous waste streams likely to be produced during reactor fuel fabrication and reprocessing. Adsorption, reverse osmosis, and ozonization methods were evaluated on a laboratory scale for their application to the treatment of wastewater. Activated carbon, macroreticular resins, and polyurethanes were tested to determine their relative capabilities for removing detergents and corrosive anions from wastewater. Conceptual flow sheets were constructed for purifying wastewater by reverse osmosis. In addition, the application of ozonization techniques for water recycle preparation was examined briefly.

42411 (RFP—2818) **Chemistry research and development. Progress report, July 1977—May 1978.** Miner, F.J. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 30 Mar 1979. Contract EY-76-C-04-3533. 54p. Dep. NTIS, PC A04/MF A01.

Studies were continued to determine the compatibility of nonnuclear weapons metals with various production processing materials. The corrosion resistance of 304L stainless steel in mixed acid environment was tested. Intergranular corrosion tests were performed on welded 21-6-9 and 304L stainless steels. A laboratory scale fast fluidized bed incineration system was installed and operating techniques developed. A new uranium chip burning process is being developed. Component development, pilot plant development, and instrumentation and statistical systems development are briefly discussed.

42412 (RHO-SA—23) **Decontamination of Hanford plutonium reclamation facility salt waste solution.** Schulz, W.W. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jun 1978. Contract EY-77-C-06-1030. 45p. (CONF-780622—80). Dep. NTIS, PC A03/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

A new precipitation-ion exchange (sodium titanate sorbent) process for removal of plutonium and americium-241 from Hanford's Plutonium Reclamation Facility salt waste solution has been successfully developed and demonstrated. The salt waste typically contains 1.3M $NaNO_3$, 0.2M $Al(NO_3)_3$, 0.1M HNO_3, 0.005 to 0.02M each of Fe^{3+}, Mg^{2+}, and Ca^{2+}, 150 to 300 μCi/l ^{241}Am, and 20 μCi/l plutonium. Addition of sufficient NaOH to adjust the waste to 0.5 - 2M OH^- and precipitate iron, calcium, and magnesium removes >99.9 percent of the ^{241}Am and 80 to 90 percent of the plutonium. Subsequent passage of 3,000 to 4,000 column volumes of clarified alkaline solution through a bed of 40 to 140 mesh sodium titanate powder reduces the ^{241}Am concentration to <0.0002-0.0016 μCi/l and the plutonium concentration to <0.001-0.004 μCi/l. For reference, the Maximum Permissible Concentrations for ^{239}Pu and ^{241}Am in water in an uncontrolled zone are 0.005 and 0.004 μCi/l, respectively.

42413 (RHO-SA—54) **Technological challenges in the immobilization of Hanford defense waste.** Kupfer, M.J.; Strachan, D.M.; Schulz, W.W. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Nov 1978. Contract EY-77-C-06-1030. 10p. (CONF-781121—25). Dep. NTIS, PC A02/MF A01.

From Annual meeting of Materials Research Society; Boston, MA, USA (28 Nov 1978).

One option for the long-term management of Hanford defense waste involves retrieval of the waste, dissolution of the salt cake and slurries in water, physical separation of the insoluble sludges, and removal of long-lived radionuclides. The waste to be immobilized would consist of the sludges and the concentrated radionuclide fraction. Development of an acceptable immobilization form for these highly variable wastes is the technological challenge which must be met. (DLC)

42414 **Development of the Krypton Absorption in Liquid CO_2 (KALC) process: mass transfer efficiencies of packed columns.** Gilliam, T.M. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **43**: No. 1, 75-87(Apr 1979).

Experiments to determine the mass transfer efficiencies of the packed columns making up the Krypton Absorption in Liquid CO_2 (KALC) process were performed at a nominal pressure of 2 MPa over a wide range of flow rates and flow ratios for the CO_2—O_2—Kr system. The height of the transfer unit values, which were relatively independent of gas or liquid flow rates, were 0.13 m for krypton in the absorber, 0.16 m for O_2 in the fractionator, and 0.21 m for krypton in the stripper.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 42392, 42394, 42401, 42403, 42404, 42433, 42434, 42435, 42437, 43580, 43760, 43832, 43856, 43857, 43864, 43866, 43868

42415 (AECL—6313) **Long-term storage of irradiated CANDU fuel under water.** Walker, J.F. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1979. 24p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In this report, the various factors influencing the long-term integrity of stored fuel are considered. The discussion is specifically limited to zirconium-alloy-clad uranium dioxide fuel and evidence from Canada and elsewhere is considered. Under storage conditions, changes take place so slowly, if at all, that no evidence has been obtained that indicates any deterioration of stored fuel after 10 to 15 years under water. All the information now available indicates that irradiated CANDU fuel may be safely stored by the present methods as long as it is technically and economically desirable to do so. Stored fuel should continue to be examined after increasingly long storage times under water to confirm the stability of the Zircaloy cladding containing the fuel pellets.

42416 (AECL—6314) **Management of radioactive fuel wastes: the Canadian disposal program.** Boulton, J. (ed.). (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Oct 1978. 143p. Dep. NTIS (US Sales Only), PC A07/MF A01.

This report describes the research and development program to verify and demonstrate the concepts for the safe, permanent disposal of radioactive fuel wastes from Canadian nuclear reactors. The program is concentrating on deep underground disposal in hard-rock formations. The nature of the radioactive wastes is described, and the options for storing, processing, packaging and disposing of them are outlined. The program to verify the proposed concept, select a suitable site and to build and operate a demonstration facility is described.

42417 (AECL—6318) **GARD: a computer program for the Geochemical Assessment of Radionuclide Disposal.** Rosinger, E.L.J.; Tremaine, K.K.R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1978. 55p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The computer program GARD is being used to calculate the rate of movement of radionuclides from a proposed deep underground vault to the surface or near surface environment. The conceptual model represents a deep underground vault in igneous rock and a system of fissures which connect the vault with the surface of the geologic formation. After a certain initial period (container integrity time), during which there is assumed to be no release, the radionuclides are assumed to be released from a vault within a certain time (leach time) and transported as dissolved species by groundwater. Important phenomena influencing their transport are convection, radioactive decay and physicochemical processes such as sorption, ion exchange and precipitation. From the material balance, a set of partial differential equations has been formulated. Simultaneous solution of these equations by the Laplace transform technique leads to expressions for the discharge rates of radionuclide chains as a function of time and distance.

42418 (AECL—6322) **Risk assessment for radioactive waste disposal.** Lyon, R.B.; Rosinger, E.L.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1979. 21p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The objectives of risk assessment studies for radioactive waste disposal are: to specify the features that prevent the escape of radionuclides from a deep disposal vault, to estimate how effective these features are likely to be, and to determine the potential consequences of the expected situation and conceivable but unlikely situations. The major features to be analyzed include the insoluble nature of the waste form itself, the resistance of its container to

corrosion or mechanical damage, the effectiveness of the massive rock barrier and the hold-up and dilution of radionuclides in the surface environment. Computer modelling is used in a technique called pathway analysis to bring together the experimental data, field data and understanding of the relevant phenomena into an assessment of the resultant effect on man and the environment.

42419 (DOE/ET—0028(Vol.3)) **Technology for commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 492p. Dep. NTIS, PC A21/MF A01.

Conceptual facilities for interim storage of various treated transuranic (TRU) and gaseous wastes produced during fuel reprocessing and mixed oxide fuel fabrication are described in volume 3. Alternatives for interim storage of spent fuel prior to reprocessing or geologic isolation are also described. The storage concepts are based on available technology. They do not necessarily represent optimum designs, but are representative of what could be achieved with current capabilities. In actual applications it is reasonable to expect that there could be some improvements over these concepts, reflected in lower costs, lower environmental impacts, or both. These conceptual descriptions provide a reasonable basis for cost analysis and for development of estimates of environmental impacts. Sections are devoted to: storage of high-level liquid waste in large stainless steel tanks; two interim storage concepts for fuel residue waste (fuel hulls and hardware) waste storage; storage concepts for other non-high-level TRU waste; two alternatives for storage of solidified high-level waste; conceptual storage for large quantities of plutonium oxide; a concept for storing krypton gas cylinders; and alternatives for both short-term and extended storage of spent fuel.

42420 (DPSPU—79-11-2) **History of waste tank 24, 1962—1974.** McNatt, F.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Apr 1979. Contract EY-76-C-09-0001. 53p. Dep. NTIS, PC A04/MF A01.

Tank 24 was placed in service in April 1963 receiving HW concentrate from the Building 242-H evaporator. The tank was filled by October 1965. In October 1966 the cooled concentrate supernate was decanted. The tank was again filled with concentrate by March 1967, then decanted in June 1967 and refilled by July 1967. Since that time the tank has remained in service storing LW and HW salt and receiving spent zeolite from the cesium removal column (CRC). In April 1973 an influx of slightly contaminated water in the bottom leak detection sump was observed. The tank was inspected with an optical periscope and numerous tests and investigations were conducted but the source of the contaminated water was not determined. However, subsequent to this report period a D_2O tracer test in tank 21 which also experienced an influx of contaminated water into its bottom sump provided conclusive evidence of communication between the tank vapor space and the bottom leak detection sump. The D_2O tracer test was documented in DPSPU 76-11-19. Inspections of the tank interior were performed by direct observation and photography using an optical periscope inserted through access risers in the roof. Samples of the vapor condensate and supernate in the tank, and liquid collected in the bottom leak detection sump were analyzed. Numerous temperature profiles were taken and several equipment modifications and repairs were made.

42421 (DPSPU—79-11-5) **History of waste tank 22, 1965—1974.** McNatt, F.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Apr 1979. Contract EY-76-C-09-0001. 45p. Dep. NTIS, PC A03/MF A01.

Tank 22 (a 1,300,000-gallon Type IV tank) was placed in service June 6, 1965, receiving HW from tank 21. The HW was transferred back into tank 21 in September 1965 and fed to the Building 242-H evaporator. This recycled concentrate and concentrate from other waste was then received in tank 22 until the tank was filled. The HW concentrate and salt remained in the tank until November 1971 when removal was begun. The concentrated supernate was transferred from the tank followed by dissolution and removal of salt from the tank walls and bottom. The salt removal was completed in May 1974 and since that time tank 22 has served as a receiver of LW from Building 221-H. Inspections of the tank interior were made using a 40-ft optical periscope and the steel thickness of the tank bottom was measured ultrasonically. Samples of the tank vapors and liquid collected in the sidewall and bottom sumps were analyzed. Temperature and specific gravity measurements were made of waste stored in the tank. Several equipment modifications and repairs were made.

42422 (LBL—8730(Vol.1)) **Heater test planning for the near surface test facility at the Hanford reservation.** DuBois, A.; Binnall, E.; Chan, T.; McEvoy, M.; Nelson, P.; Remer, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 93p. Dep. NTIS, PC A05/MF A01.

The underground test facility NSTF being constructed at Gable Mountain, is the site for a group of experiments designed to evaluate the thermo-mechanical suitability of a deep basalt stratum as a permanent repository for nuclear waste. Thermo-mechanical modeling was performed to help design the instrumentation arrays for the three proposed heater tests (two full scale tests and one time scale test) and predict the thermal environment of the heaters and instruments. The modeling does not reflect recent RHO revisions to the in situ heater experiment plan. Heaters, instrumentation, and data acquisition system designs and recommendations were adapted from those used in Sweden. (DLC)

42423 (NVO—196-9) **Nevada Nuclear Waste Storage Investigations. FY 1979 project plan.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Mar 1979. 111p. Dep. NTIS, PC A06/MF A01.

This document presents the management and cost for the Nevada Nuclear Waste Storage Investigations (disposal of high-level wastes at Nevada Test Site) and provides a complete description of the overall project, management structure, technical approach, and work breakdown structure. The document is organized into five major sections. Section I summarizes the history of the project and indicates a potential future course of action. FY 1979 project work is briefly described in Section II. Section III outlines the delegated responsibilities of all project management functions. A list of critical questions that guide the technical approach of the project are presented in Section IV. Section V contains subtask work plans which outline the work in detail for this fiscal year.

42424 (RHO-SA—26) **Ground-water hydrology and radioactive waste disposal at the Hanford Site.** Law, A.G. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Feb 1979. Contract EY-77-C-06-1030. 35p. (CONF-790219—9). Dep. NTIS, PC A03/MF A01.

From AIME annual meeting; New Orleans, LA, USA (18 Feb 1979).

This paper is a summary of the hydrologic activities conducted at the Hanford Site as a part of the environmental protection effort. The Site encompasses 1,480 square kilometers in the arid, southeastern part of Washington State. Precipitation averages about 160 millimeters per year with a negligible amount, if any, recharging the water table, which is from 50 to 100 meters below the ground surface. An unconfined aquifer occurs in the upper and middle Ringold Formations. The lower Ringold Formation along with interbed and interflow zones in the Saddle Mountain and Wanapum basalts forms a confined aquifer system. A potential exists for the interconnection of the unconfined and confined aquifer systems, especially near Gable Mountain where the anticlinal ridge was eroded by the catastrophic floods of the ancestral Columbia River system. Liquid wastes from chemical processing operations have resulted in large quantities of processing and cooling water disposed to ground via ponds, cribs, and ditches. The ground-water hydrology program at Hanford is designed: (1) to define and quantify the ground-water flow systems, (2) to evaluate the impact of the liquid waste discharges on these flow systems, and (3) to predict the impact on the ground-water systems of changes in system inputs. This work is conducted through a drilling, sampling, testing, and modeling program.

42425 (RHO-ST—1) **Status of liquid waste leaked from the 241-T-106 tank.** Brown, D.J.; Routson, R.C.; Price, W.H.; Fecht, K.R. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Feb 1979. Contract EY-76-C-06-1030. 24p. Dep. NTIS, PC A02/MF A01.

On June 8, 1973, the 241-T-106 tank, located on the Hanford Site, was confirmed as leaking. Approximately 4.35×10^5 liters (115,000 gallons) of liquid containing 40,000 curies of cesium-137, 14,000 curies of strontium-90, 6 curies of plutonium and americium, and 297,000 curies of various fission products (with half-lives less than 5 years) were released to the glaciofluvial sediments surrounding the tank. Subsequent to the leak, studies were conducted to monitor and assess the potential for migration of radioactivity to points of potential uptake. These studies included: the drilling of monitoring wells to provide access for in situ instrumentation and to collect sediment samples for geologic and radionuclide analysis; in situ total gamma logging of wells to monitor changes in the leak plume; in situ gamma energy analysis measurements to determine species and concentrations of radionuclides in the leak plume; and, computer modeling to predict future changes in the plume.

42426 (RHO-ST—17) **Distribution of plutonium and americium beneath the 216-Z-1A Crib: a status report.** Price, S.M.; Kasper, R.B.; Additon, M.K.; Smith, R.M.;Last, G.V. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Feb 1979. Contract EY-77-C-06-1030. 221p. Dep. NTIS, PC A10/MF A01.

Past liquid waste disposal practices at the Hanford site have included the discharge of actinide-bearing liquid waste directly to the ground via structures termed cribs. A study to characterize the current distribution of plutonium and americium in sediments beneath one of these retired facilities, the 216-Z-1A Crib, has been conducted. To obtain distribution data, wells were drilled through

and around the crib using specially developed containment and sampling techniques. Sediment samples collected during drilling were geologically characterized and analyzed for plutonium and americium content. The acquired data were used to construct geologic cross sections and isopleth cross sections of plutonium and americium concentrations with depth. Mechanisms which may have been responsible for the determined pattern of plutonium and americium distribution were also considered. 15 figures, 7 tables.

42427 (UCRL—13997) **Notes on the next generation macromodel: a unified computations system for predicting post sealing waste depository performance.** Kaplan, S.; Kaufman, A.M.; Lathrop, J.W. (Kaplan and Associates, Inc., Livermore, CA (USA)). Aug 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

Development and improvement activities are underway on computer software and on several analytical ideas related to the calculations of the risk from waste migration after sealing of a depository. Purpose of this report is to pull together these software and analytical ideas into an overall portrayal or blueprint of the new macromodel that is evolving, in order to clarify the relationship of the components and the interfaces required, to facilitate the alignment of all parties concerned and to allow a definitive specification of the work remaining to be done.

42428 (UCRL—15011) **Documentation information for peer group review report site suitability criteria study.** (Golder Associates, Inc., Kirkland, WA (USA)). Oct 1977. Contract W-7405-ENG-48. 104p. Dep. NTIS, PC A06/MF A01.

This report presents documentation of the geotechnical input data provided by Golder Associates, Inc. (GAI) for the Cycle II repository model analysis. Information relating to the proposed uncertainty analysis and several appropriate comments pertinent to the overall site suitability study are also included. GAI was responsible for developing descriptors and coefficients for the TASC model hydrologic analog; permeability and porosity values for the geologic formations (excepting salt); occurrence and properties of the bore hole seals, backfill, and mine fracture zones; and properties of fracture zones associated with faults. All data are presented with a preferred value and maximum credible range. These values relate to a generic repository in a sedimentary basin and not a specific site. 13 figures, 6 tables. (RWR)

42429 (Y/OWI/SUB—7118/1) **Thermoelastic analysis of spent fuel and high level radioactive waste repositories in salt. A semi-analytical solution.** St. John, C.M. (Minnesota Univ., Minneapolis (USA). Dept. of Civil and Mineral Engineering). Apr 1977. Contract W-7405-ENG-26. 106p. Dep. NTIS, PC A06/MFA01.

An underground repository containing heat generating, High Level Waste or Spent Unreprocessed Fuel may be approximated as a finite number of heat sources distributed across the plane of the repository. The resulting temperature, displacement and stress changes may be calculated using analytical solutions, providing linear thermoelasticity is assumed. This report documents a computer program based on this approach and gives results that form the basis for a comparison between the effects of disposing of High Level Waste and Spent Unreprocessed Fuel.

42430 (Y/OWI/SUB—7118/2) **EXPAREA: a computer code for analysis of test scale underground excavations for disposal of radioactive waste in bedded salt deposits.** St. John, C.M. (Minnesota Univ., Minneapolis (USA). Dept. of Civil and Mineral Engineering). Apr 1978. Contract W-7405-ENG-26. 96p. Dep. NTIS, PC A05/MF A01.

This report documents the three dimensional, displacement discontinuity based computer code known as EXPAREA. The code is intended specifically to model test scale underground sites at which simulated or real radioactive waste is emplaced in salt. Documentation includes the necessary theory, details of implementation and the results of a number of test runs as well as user instructions, flowcharts and program listing.

42431 **Probabilistic risk analysis of radioactivity release and transport from geologic disposal of radioactive wastes.** Bertozzi, G.; Caretta, A.; Schneider, H. (Commission of the European Communities, Ispra, Italy). pp IX.4.1-IX.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

An integrated modeling system for calculating radionuclide release and biosphere transport processes from geologic depositories to man, is presented. Because of large uncertainties in the major input data, a probabilistic approach has been followed, giving the results in form of histograms. This technique allows the identification of those parameters which control the model results and on which major effort may be focused.

42432 **Probabilistic reliability analysis of the high activity level liquid waste storage system in the Belgoprocess Reprocessing Plant.** Dekais, J.J.; De Beukelaer R. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp IX.6.1-IX.6.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The storage of the high activity level liquid waste (HLLW) in a spent fuel reprocessing plant, is one of the systems involving the most serious safety questions. A reliability study was performed using a method similar to that reported in the WASH-1400 report (N.C. Rasmussen, "An Assessment of Accident Risk in US Commercial Nuclear Power Plants", August 1974). In addition to that, a time factor was added for each event. The reliability analysis shows a continuous evolution of the system behavior. The probability to lose the HLLW cooling systems and atmosphere dilution systems is computed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42417, 42425, 42959, 42960, 43756, 43757, 43759, 43761, 43762, 43773, 43774, 43788, 43832

42433 (DOE/ET—0029(Vol.1)) **Environmental aspects of commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 587p. Dep. NTIS, PC A25/MF A01.

Environmental effects (including accidents) associated with facility construction, operation, decommissioning, and transportation in the management of commercially generated radioactive waste were analyzed for plants and systems assuming a light water power reactor scenario that produces about 10,000 GWe-yr through the year 2050. The following alternative fuel cycle modes or cases that generate post-fission wastes requiring management were analyzed: a once-through option, a fuel reprocessing option for uranium and plutonium recycle, and a fuel reprocessing option for uranium-only recycle. Volume 1 comprises five chapters: introduction; summary of findings; approach to assessment of environmental effects from radioactive waste management; environmental effects related to radioactive management in a once-through fuel cycle; and environmental effects of radioactive waste management associated with an LWR fuel reprocessing plant. (LK)

42434 (DOE/ET—0029(Vol.2)) **Environmental aspects of commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 492p. Dep. NTIS, PC A21/MF A01.

Volume 2 contains chapters 6 through 10: environmental effects related to radioactive waste management associated with LWR fuel reprocessing - mixed-oxide fuel fabrication plant; environmental effects related to transporting radioactive wastes associated with LWR fuel reprocessing and fabrication; environmental effects related to radioactive waste management associated with LWR fuel reprocessing - retrievable waste storage facility; environmental effects related to geologic isolation of LWR fuel reprocessing wastes; and integrated systems for commercial radioactive waste management. (LK)

42435 (DOE/ET—0029(Vol.3)) **Environmental aspects of commercial radioactive waste management.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 330p. Dep. NTIS, PC A15/MF A01.

Volume 3 contains eight appendices: a reference environment for assessing environmental impacts associated with construction and operation of waste treatment, interim storage and/or final disposition facilities; dose calculations and radiologically related health effects; socioeconomic impact assessments; release/dose factors and dose in 5-year intervals to regional and world wide population from reference integrated systems; resource availability; environmental monitoring; detailed dose results for radionuclide migration groundwater from a waste repository; and annual average dispersion factors for selected release points. (LK)

42436 (NP—23779) **Homestake Mining Company Pitch Project. Final environmental statement.** (Forest Service, Delta, CO (USA)). 14 Jul 1978. 415p. USDA Forest Service, Delta, CO.

This Final Environmental Impact Statement was prepared as a cooperative effort by the U.S. Forest Service, the State of Colorado, and the U.S. Nuclear Regulatory Commission in response to an application by the Homestake Mining Company for authorization to mine and mill uranium ore at their Pitch Project location in Saguache County, Gunnison National Forest, Colorado. The Statement describes numerous alternatives affecting mining and milling operations. The Statement discusses the estimated effects of implementing each of the alternatives. The preferred actions are identified.

42437 (UCRL—15027) **REPFLO model evaluation, physical and numerical consistency.** Wilson, R.N.; Holland, D.H. (New Millennium Associates, Santa Barbara, CA (USA)). Nov 1978. Contract W-7405-ENG-48. 117p. Dep. NTIS, PC A06/MF A01.

This report contains a description of some suggested changes and an evaluation of the REPFLO computer code, which models ground-water flow and nuclear-waste migration in and about a nuclear-waste repository. The discussion contained in the main body of the report is supplemented by a flow chart, presented in the Appendix of this report. The suggested changes are of four kinds: (1) technical changes to make the code compatible with a wider variety of digital computer systems; (2) changes to fill gaps in the computer code, due to missing proprietary subroutines; (3) changes to (a) correct programming errors, (b) correct logical flaws, and (c) remove unnecessary complexity; and (4) changes in the computer code logical structure to make REPFLO a more viable model from the physical point of view.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 42369, 42376, 42390, 42392, 42394, 42418, 42431, 42432

42438 (NUREG/CR—0628) **Prediction of the net radon emission from a model open pit uranium mine.** Nielson, K.K.; Perkins, R.W.; Schwendiman, L.C.; Enderlin, W.I. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 21p. (PNL—2889). Dep. NTIS, PC A02/MF A01.

Radon emission from a model open pit uranium mining operation has been estimated by applying radon exhalation fluxes measured in an open pit uranium mine to the various areas of the model mine. The model mine was defined by averaging uranium concentrations and production and procedural statistics for eight major open pit uranium mines in the Casper, Wyoming area. The resulting emission rates were 740 Ci/AFR during mining operations and 33 Ci/AFR/yr after abandonment of the mine.

42439 **Radiological impact of thorium mining and milling.** Meyer, H.R.; Till, J.E.; Bomar, E.S.; Bond, W.D.; Morse, L.E.; Tennery, V.J.; Yalcintas, M.G. (Oak Ridge National Lab., TN). *Nucl. Saf.;* **20**: No. 3, 319-330(May 1979).

Implementation of an alternate fuel usage scheme involving ^{233}U would require very large increases in ^{232}Th production rates, probably necessitating the mining of thorite ($ThSiO_4$) from western U.S. deposits. This article reviews current estimates of the extent of that resource and estimates the radiological impact of operating a thorium mine and mill in the region. Radiological doses to a hypothetical maximally exposed individual located 1.6 km from the site are estimated to be 2.4 mrems (to total body), 9.5 mrems (to bone), and 35.3 mrems (to lungs). These doses are due primarily to ingestion and inhalation of ^{220}Rn daughters, ^{228}Ra and ^{232}Th. Doses to the general population in the area surrounding the site and postoperational doses due to tailings pile releases are also calculated.

42440 **Some aspects of the risks associated with a mixed oxide fuel production plant.** Candolfo, G. (AGIP Nucleare, Milan, Italy); Lomazzi, F.; Caretta, A.; Mancini, G.; Rocco, P.; Schneider, H. pp IX.2.1-IX.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The risks associated with a mixed oxide fuel fabrication plant are reviewed. The study focuses on a detailed probabilistic analysis of one of the major conceivable internal accidents: fire in a hot cell. The probabilistic methodology used calls for a development of the accident event tree with the related analysis of the intervening system fault-trees; moreover, a spectrum of possible fire magnitudes is assumed and for each fire event the Pu-release at the stack is evaluated by an original computer model. The final results, depicted in the form of a histogram, show the low risk to be associated with the fire accident and, more generally, with internal accidents. However, high building contamination values can be attained in some of the events considered.

REGULATIONS

42441 **Proceedings, Annual Meeting--Institute of Nuclear Materials Management, 19th, 1978.** (Inst Nucl Mater Manage, Piketon, Ohio). *Nucl. Mater. Manage.;* 7: 1-538(1978).

In this conference 57 papers are presented, 47 of which are abstracted separately. The subject matter is primarily concerned with the safe protection of and uses for nuclear material. In particular, material control and accounting systems are stressed.

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 42399

42442 (AECL—6347) **Application of safeguards design principles to the spent fuel bundle counter for 600 MW CANDU reactors.** Stirling, A.J.; Allen, V.H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1978. 16p. (CONF-781007—19; IAEA-SM—231/38). Dep. NTIS (US Sales Only), PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

The irradiated fuel bundle counters for CANDU 600 MW reactors provide the IAEA with a secure and independent means of estimating the inventory of the spent fuel storage bay at each inspection. Their function is straightforward: to count the bundles entering the storage area through the normal transfer ports. However, location, reliability, security and operating requirements make them highly intelligent instruments which have required a major development program. Moreover, the bundle counters incorporate principles which apply to many unattended safeguards instruments. For example, concealing the operating status from potential diverters eases reliability specifications, continuous self-checking gives the inspector confidence in the readout, independence from continuous station services improves tamper resistance, and the detailed data display provides tamper indication and a high level of credibility. Each irradiated fuel bundle counter uses four Geiger counters to detect the passage of fuel bundles as they pass sequentially through the field-of-view. A microprocessor analyzes the sequence of the Geiger counter signals and determines the number and direction of bundles transferred. The readout for IAEA inspectors includes both a tally and a printed log. The printer is also used to alert the inspector to abnormal fuel movements, tampering, Geiger counter failures and contamination of the fuel transfer mechanism.

42443 (LA—7616-PR) **Nuclear safeguards research and development. Program status report, May—August 1978.** Gardner, S.D. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 105p. Dep. NTIS, PC A06/MF A01.

This report presents the status of the Nuclear Safeguards Research and Development program pursued by LASL Safeguards Groups Q-1, Q-2, Q-3, and Q-4. Topics covered include nondestructive assay technology development and applications, international safeguards, perimeter safeguards and surveillance, concepts and subsystems development (e.g., DYMAC program), integrated safeguards systems, training courses, and technology transfer. Salient features of the program and technical progress during the current reporting period are outlined in the Executive Summary.

42444 (LA—7699) **Irradiated fuel monitors: preliminary feasibility study.** Dowdy, E.J.; Caldwell, J.T. (comps.). (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

Eight attribute measurement techniques for confirmation of declared irradiated fuel inventories in water-filled storage ponds at nuclear installations under safeguards surveillance are discussed. Four of the eight techniques are deemed suitable for further investigation, with the Cherenkov glow intensity measurement being the only technique that does not require disturbance of the storage ponds. 11 figures.

42445 (LA—7728-MS) **Verification station for Sandia/Rockwell Plutonium Protection system.** Nicholson, N.; Hastings, R.D.; Henry, C.N.; Millegan, D.R. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 26p. Dep. NTIS, PC A03/MF A01.

A verification station has been designed to confirm the presence of plutonium within a container module. These container modules [about 13 cm (5 in.) in diameter and 23 cm (9 in.) high] hold sealed food-pack cans containing either plutonium oxide or metal and were designed by Sandia Laboratories to provide security and continuous surveillance and safety. After the plutonium is placed in the container module, it is closed with a solder seal. The verification station discussed here is used to confirm the presence of plutonium in the container module before it is placed in a carousel-type storage array inside the plutonium storage vault. This measurement represents the only technique that uses nuclear detectors in the plutonium protection system.

42446 (LA-UR—79-938) **Simulated neutron tomography for nondestructive assays.** Kruger, R.P.; Morris, R.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

The results of an on-going research project to assess the use of resonance-neutron computed-tomography for the assay of fissile materials will be discussed. A simulation study has indicated the potential value of this technique for the nondestructive inspection of a standard to be fabricated by the National Bureau of Standards.

42447 (LA-UR—79-1021) **DYMAC computer system.** Hagen, J.; Ford, R.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790430—5). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

The DYnamic Materials ACcountability program (DYMAC) has been monitoring nuclear material at the Los Alamos Scientific Laboratory plutonium processing facility since January 1978. This paper presents DYMAC's features and philosophy, especially as reflected in its computer system design. Early decisions and tradeoffs are evaluated through the benefit of a year's operating experience.

42448 (LA-UR—79-1029) **Experience with installation and operation of digital electronic balances.** Severe, W.R.; Thomas, C.C. Jr.; Stephens, M.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790430—7). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

Los Alamos Scientific Laboratory is implementing a near real-time nuclear material control program. Digital electronic balances interfaced directly to a central computer are an important part of this program. Weighing errors are characterized and several methods of installation are discussed in terms of the impact on measurement errors.

42449 (LA-UR—79-1037) **Nondestructive determination of burnup and cooling times of irradiated fuel assemblies.** Phillips, J.R.; Hsue, S.T.; Kaieda, K.; Lee, D.M.; Halbig, J.K.; Medina, E.G.; Hatcher, C.R.; Bement, T.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790430—8). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

The applicability of nondestructive gamma-ray and neutron techniques for the characterization of irradiated fuel assemblies has been investigated. Consistency of relative cooling times can be verified using specific isotopic ratios. The axial activity profiles of assemblies have been measured using a variety of detectors. Declared burnup values for MTR, BWR, and PWR assemblies have been correlated with the $^{134}Cs/^{137}Cs$ and $^{154}EU/^{137}Cs$ isotopic ratios.

42450 (LA-UR—79-1038) **X-ray L/sub III/-edge densitometer for assay of mixed S.N.M. solutions.** Russo, P.A.; Canada, T.R.; Langner, D.G.; Tape, J.W.; Hsue, S.T.; Cowder, L.R.; Mosley, W.C.; Reynolds, L.; Thompson, M.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790430—9). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

Simultaneous nondestructive analysis of uranium and plutonium in coprocessed solutions is accomplished using L/sub III/-edge densitometry in at-line instrumentation. The densitometer measures the transmission through solutions of a continuous x-ray spectrum, and gives accuracies of approximately one-half percent and three percent for uranium and plutonium concentrations respectively.

42451 (MLM—2610(OP)) **Dynamic calibration: a measurement control technique for nondestructive assay of special nuclear materials.** Lemming, J.F. (Monsanto Research Corp., Miamisburg, OH (USA); Mound Facility, Miamisburg, OH (USA)). 1979. Contract AC04-76DP00053. 3p. (CONF-790430—10). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

Dynamic calibration is a measurement control technique designed to facilitate the use of nondestructive assay for the control and accounting of a special nuclear material. The main features of dynamic calibration are a verification technique which ensures the choice of appropriate calibration materials and a dynamic sensor which verifies the calibration curve. A system approach is used to describe calibration in terms of an instrument sensor module, a regression module, a dynamic sensor module, and a control module. Data from a measurement system which uses spontaneous fission detection as the primary assay technique and calorimetric assay as a control measurement are used to demonstrate the function of each module.

42452 (NUREG—0459) **Generic adversary characteristics: summary report.** Stewart, J.B. Jr.; Davidson, J.J.; Jones, H.B.; Fulwiler, C.H.; Mullen, S.A. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Jul 1978. 64p. NTIS, PC A04/MF A01.

The adversaries studied were found to be complex, often unpredictable, and dynamic. The adversary typically goes through a complex decision-making process between the time a potential target is identified and the moment the decision to act is made. This study analyzes the adversary characteristics, and the following conclusions are made: one of the least likely methods of attack is an overt armed assault. Terrorists and psychotics depend upon a high degree of personal dedication. No single generic adversary group or individual exhibits strength in every characteristic. Physical danger appears to have some deterrent effect on all adversaries except the psychotics. Organized and professional criminals often try to recruit insiders. Disoriented persons, white-collar criminals, and disgruntled employees tend to operate as insiders. Professional criminals, many terrorist groups, some extremist protest groups, and certain disoriented persons plan carefully before initiating a criminal mission. Organized crime and miscellaneous criminal adversaries rely on deception and ruse to bypass security. After the decision to commit a crime, the resources deployed by terrorists or organized criminals will be a function of their perception of the operational requirements of the crime. The nature of "threat" is dynamic; adversary behavior and capability appear to be related to prevailing political, economic, and social conditions. (DLC)

42453 (NUREG--0465(Vol.1)) **Transportation security personnel training manual.** (Argonne National Lab., IL (USA)). Nov 1978. 200p. Dep. NTIS, PC A10/MF A01.

Objective of this manual is to train security personnel to protect special nuclear materials and nuclear facilities against theft and sabotage as required by 10 CFR Part 73. This volume contains the introduction and rationale. (DLC)

42454 (NUREG—0465(Vol.2)(Pt.A)) **Transportation security personnel training manual.** (Argonne National Lab., IL (USA)). Nov 1978. 325p. Dep. NTIS, PC A15/MF A01.

This volume is the instructor's guide, covering physical exercise, terrorism, field search and restraint, criminals procedures, introduction to criminal law, offenses against property, rules of conduct, use of force, firearms qualification, self defense, arrest authority, civil liability, report writing, stress, tactics, and situational training scenarios. (DLC)

42455 (NUREG—0465(Vol.2)(Pt.B)) **Transportation security personnel training manual.** (Argonne National Lab., IL (USA)). Nov 1978. 508p. Dep. NTIS, PC A22/MF A01.

This volume is the instructor's manual for the training of SNM guards. Covered are: self-defense, arrest authority, civil liability, report writing, stress, tactics, and situational training scenarios. (DLC)

42456 (NUREG—0465(Vol.3)) **Transportation security personnel training manual.** (Argonne National Lab., IL (USA)). Nov 1978. 247p. Dep. NTIS, PC A11/MF A01.

This volume contains the student guide. It contains the introduction to the course, terrorism, field search and restraints, criminal procedures, introduction to criminal law, offenses against persons and property, rules of conduct, use of force, firearms qualification course, self defense, arrest authority, civil liability, report writing, stress, and tactics. (DLC)

42457 (NUREG—0525) **Safeguards Summary Event List (SSEL). Pre-NRC through December 31, 1978.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Dec 1978. 121p. NTIS, PC A06/MF A01.

Nine categories of events involving NRC licensed material or licensees are included. As additional information is obtained on an event, it will be incorporated in future editions. The list contains incidents as well as less significant events. The nine categories are: bomb-related (divided into two sections: (a) those events in which a bomb or explosive material was located or an explosion occurred at or in the vicinity of a licensed facility, (b) a complete chronological list), intrusion, missing and/or allegedly stolen, transportation-related, vandalism, arson, firearms-related, sabotage, and miscellaneous.

42458 (NUREG/CR—0663) **Safeguards material control and accounting at licensed processing facilities. Quarterly report, July—September 1977.** Sacks, I.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1978. Contract W-7405-ENG-48. 190p. (UCRL—52703). Dep. NTIS, PC A09/MF A01.

Objective was to develop the methodology and software needed for assessing Material Control and Accounting (MC and A) systems at fixed site nuclear fuel facilities. The assessment of an MC and A system requires five steps: target identification, event set generation, MC and A response determination, component performance models, and thermo-physical property data base. Progress on each is reported. (DLC)

42459 (NUREG/CR—0694) **Physical protection of nuclear material in-transit. Quarterly progress report, October—December 1978.** Chapman, L.D. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Feb 1979. Contract EY-76-C-04-0789. 20p. (SAND—79-0535). Dep. NTIS, PC A02/MF A01.

A major in-house activity focused on further development of the SABRES combat simulation model. Work continued this quarter on development of the Emergency Assistance Request Simulator (EARS). Science Applications, Inc. (SAI) continued to provide communication analysis support. The applicability of the Safeguards Network Analyses Procedure (SNAP) to analysis of SNM transportation systems was demonstrated.

42460 (NUREG/CR—0738) **Physical protection of nuclear material in-transit. Quarterly progress report, January—March 1979.** Chapman, L.D. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 12p. (SAND—79-0651). Dep. NTIS, PC A02/MF A01.

The major in-house activity related to the Nuclear Regulatory Commission (NRC) physical protection of nuclear material in-transit program focused on further enhancements to and testing of the SABRES II conflict model. A model of the effectiveness of small arms weapons was included in the SABRES II model, which was then tested to verify the correctness of the coding logic. Work continued on the development of a structure for evaluating compliance with the upgrade rules.

42461 (PB—288902) **Application of game theory to nuclear material accounting. Final report, 1 April 1977-3 January 1978.** Siri, W.E.; Ruderman, H.; Dresher, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 115p. NTIS PC A06/MF A01.

An approach based upon the theory of games is presented that determines an optimal alarm threshold for detecting unauthorized or deliberate diversion of nuclear material based upon material accounting data. A mathematical model is developed, solved, and applied to a generic nuclear facility. By considering a malevolent diverter as a basic ingredient of the analysis, this approach offers advantages over conventional statistical hypothesis testing. The results show that periodic inventories and appropriate interpretation of MUF (Material Unaccounted For) can provide a high assurance for indicating diversion in a nuclear material safeguards situation. The optimal policy is to select the alarm threshold by a mixed strategy rather than a pre-set single fixed value. Procedures for doing this are presented in the report. With this approach, MUF data by itself may be more useful in indicating possible unauthorized diversion of special nuclear material.

42462 (SAND—78-0660) **Plutonium Protection System (PPS). Volume 2. Hardware description. Final report.** Miyoshi, D.S. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 56p. Dep. NTIS, PC A04/MF A01.

The Plutonium Protection System (PPS) is an integrated safeguards system developed by Sandia Laboratories for the Department of Energy, Office of Safeguards and Security. The system is designed to demonstrate and test concepts for the improved safeguarding of plutonium. Volume 2 of the PPS final report describes the hardware elements of the system. The major areas containing hardware elements are the vault, where plutonium is stored, the packaging room, where plutonium is packaged into Container Modules, the Security Operations Center, which controls movement of personnel, the Material Accountability Center, which maintains the system data base, and the Material Operations Center, which monitors the operating procedures in the system. References are made to documents in which details of the hardware items can be found.

42463 (SAND—78-0697) **Motor drive chassis for the plutonium protection system.** Shaut, A.L. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

A motor drive chassis has been developed for use in the Plutonium Protection System. Rotation of the desired carrousel in a secure storage module is controlled by this chassis which supplies the power and drive pulses required by the carrousel motor. This work was sponsored by the Department of Energy/Office of Safeguards and Security (DOE/OSS) as part of the overall Sandia Fixed Physical Protection Program.

42464 (SAND—79-0059C) **Safeguards methodology development history.** Chapman, L.D.; Bennett, H.A.; Engi, D.; Grady, L.M.; Hulme, B.L.; Sasser, D.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 11p. (CONF-790430—14). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

The development of models for the evaluation and design of fixed-site nuclear facility, physical protection systems was under way in 1974 at Sandia Laboratories and has continued to the present. A history of the evolution of these models and the model descriptions are presented. Several models have been and are continuing to be applied to evaluate and design facility protection systems.

42465 (SAND—79-0575) **rf duress alarms: market survey and preliminary characterization.** Draper, B.L. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 17p. Dep. NTIS, PC A02/MF A01.

This report represents the first phase of the duress alarm studies. Presented here are the results of an extensive market survey and some preliminary observations on the effectiveness of many system components.

42466 (UCID—18115) **Analysis of the performance capability of an infrared interior intrusion detector.** Dunn, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Nov 1977. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

Component performances are required by the LLL assessment procedure for material control and accounting (MC & A) systems. Monitors are an example of an MC & A component whose functions are to process measurements or observations for purposes of detecting abnormalities. This report develops a methodology for characterizing the performance of a class of infrared (IR) interior intrusion monitors or detectors. The methodology is developed around a specific commercial IR detector, the InfrAlarm, manufactured by Barnes Engineering Company (Models 19-124 and 19-115A). Statistical detection models for computing probabilities of detection and false alarms were derived, and the performance capability of the InfrAlarm IR detector was shown using these measures. The results obtained in the performance analysis show that the detection capability of the InfrAlarm is excellent ($\sim$ 1), with very low false alarm rates, for a wide range in target characteristics. These results should be representative and particularly for nonhostile environments.

42467 (UCID—18116) **Design techniques for large scale linear measurement systems.** Candy, J.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 53p. Dep. NTIS, PC A04/MF A01.

Techniques to design measurement schemes for systems modeled by large scale linear time invariant systems, i.e., physical systems modeled by a large number ($>$ 5) of ordinary differential equations, are described. The techniques are based on transforming the physical system model to a coordinate system facilitating the design and then transforming back to the original coordinates. An example of a three-stage, four-species, extraction column used in the reprocessing of spent nuclear fuel elements is presented. The basic ideas are briefly discussed in the case of noisy measurements. An example using a plutonium nitrate storage vessel (reprocessing) with measurement uncertainty is also presented.

42468 (UCRL—13891-3) **Human vigilance investigation analysis of the pattern array test (further data analysis). Final report.** Have, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Polytechnic State Univ., San Luis Obispo (USA). Foundation). Apr 1979. Contract W-7405-ENG-48. 68p. Dep. NTIS, PC A04/MF A01.

This report analyzes a test which was designed to help solve problems of human vigilance encountered in a material safeguard system. The test was designed to determine the efficiency of an operator when processing large amounts of information from a video screen over extended periods of time. In the test eight objects, either circles, squares, or triangles, were set in a 5 x 5 matrix which appeared on a video screen. The eight objects were shown for a specified length of time, the screen blanked out for another specified period, then eight objects in the same 5 x 5 matrix were again shown. The observer was tested on his ability to discern changes in patterns and/or symbols from frame to frame. The testees were able to identify changes in pattern easier than changes in symbols.

42469 (UCRL—13977) **Generic data base for security equipment and its utility in the safeguards inspection process. Final report 8151-79-FR-16.** Scala, S. (SRI International, Menlo Park, CA (USA)). 10 Feb 1979. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

This report contains material presented at the Nuclear Regulatory Commission (NRC) conference of regional inspectors in Atlanta, Georgia, on January 17, 1979. It describes the contents of the generic data base for security equipment, which was developed by SRI for NRC under a Sandia Laboratories' subcontract, and examines its potential utility in the process of inspection of NRC-licensed facilities.

42470 (UCRL—15012) **Definition, development, and demonstration of analytical procedures for the structured assessment approach. Final report.** (Applied Decision Analysis, Inc., Menlo Park, CA (USA)). 15 Apr 1979. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Analytical procedures were refined for the Structural Assessment Approach for assessing the Material Control and Accounting systems at facilities that contain special nuclear material. Requirements were established for an efficient, feasible algorithm to be used

in evaluating system performance measures that involve the probability of detection. Algorithm requirements to calculate the probability of detection for a given type of adversary and the target set are described.

42471 (UCRL—82210) **On-line safeguards design: an application of estimation/detection.** Candy, J.V.; Dunn, D.R.; Rozsa, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1979. Contract W-7405-ENG-48. 10p. (CONF-790430—5). Dep. NTIS, PC A02/MF A01.

From 1. annual symposium on safeguards and nuclear material management; Brussels, Belgium (25 Apr 1979).

The applicability of madern signal processing techniques to the safeguards problem for a plutonium nitrate storage tank and concentrator is addressed. The techniques involve mathematical modeling, optimal estimation of process variables, and the detection of abnormal changes in these variables due to adversary diversion. The performance of these techniques is preesented for various diversion scenarios.

42472 Coordinated safeguards for materials management in chemical separation, conversion, and fuel fabrication facilities. Dayem, H.A.; Cobb, D.; Dietz, R.J.; Hakkila, E.A.; Shipley, J.P.; Smith, D.B. (Univ of Calif, Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* 7: 126-133(1978).

The benefits of dynamic materials accounting are demonstrated by comparing the timeliness, spatial specificity, and sensitivity with that of current materials accounting requirements. Examples of conceptual dynamic accountability systems are given for proposed domestic fuel-cycle facilities. Modeling and simulation results indicate that such systems can detect diversion in hours or days with improved diversion sensitivity and can localize diversion to a single unit process area. 17 refs.

42473 Effect of International Atomic Energy Agency inspections at selected United States facilities. Lang, R.E.; Colsmann, P.; Kops, S. (DOE, Chicago, Ill). *Nucl. Mater. Manage.;* 7: 226-232(1978).

Since the early 1960s, several United States facilities have been subject to IAEA inspections. This paper presents a discussion of IAEA inspection activities at some of these facilities from the viewpoint of the facility that was 'inspected,' and discusses the impact that these inspection activities had at each facility. This paper will also address the evolution of the inspection program through the period.

42474 U.S. Department of Energy response capability to nuclear threats. Allen, G.C.; Koopman, F.D. (US DOE, Las Vegas, Nev). *Nucl. Mater. Manage.;* 7: 293-297(1978).

The U.S. Department of Energy has formed a special group of scientists, engineers and technicians and developed equipment and procedures to provide technical assistance to the Federal Bureau of Investigation in responding to a threat by an individual or group to detonate a nuclear explosive or to scatter radioactive material. The group is called the Nuclear Emergency Search Team (NEST). Appropriate elements of NEST can be rapidly mobilized and transported to the scene of a threat. DOE personnel and equipment are prepared to evaluate threat credibility, conduct a search, perform diagnostics, assess probability of nuclear yield or spread of radioactive material, assess damage potential and assist in render safe and disposal operations.

42475 Dynamic materials control development and demonstration program. Augustson, R.H. (Univ of Calif, Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* 7: 305-318(1978).

The current status of the DOE real time Dynamic Materials Control program, DYMAC, being developed at the Los Alamos Scientific Laboratory, is reviewed and the next phase of the program is discussed. 6 refs.

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

REFER ALSO TO CITATION(S) 44143

42476 (LA—7695-MS) **Existence and lifetime of laser fusion pellets containing tritium.** Devaney, J.J. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

Cryogenic pellets containing significant amounts of solid tritium cannot be maintained in a pure vacuum for longer than (typically) some tens of seconds because radiative cooling at low temperatures is inefficient. The steady state temperatures in typical one- and two-shell pellet designs both in vacuum and with external cooling, as well as the lifetimes of pellets following cooling removal, are calculated.

42477 (LA—7790-MS) **Cooling of DT and T_2 cryogenic pellets within very low density plastics and by helium.** Devaney, J.J. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

We have established previously that typical DT pellets cannot be kept solid with external cooling through pure vacuum, and can only be maintained solid within DT gas-filled spaces over a limited range of cooling temperatures. This report examines whether low-density (0.01 g/cm^3 or 0.05 g/cm^3) polyethylene foam or helium gas have sufficient conductivity to allow inner tritium-containing shells to be kept solid. For both conductors the answer is affirmative, but some uncertainty exists concerning the conductivity of foams and the worst excursions might not provide enough conductivity. For helium much less than one millitorr pressure suffices for cooling typical pellets. For cooling the same nuclear fuel concentrated in the form of a central ball, the lightest foams are marginal but might be satisfactory at the highest excursion of our conductivity error. Required helium pressures for ball cooling are in the region of a millitorr. A simple model for the ratio of foam to solid conductivity of a substance is developed.

42478 Temporally and spatially resolved harmonic emission from spherical laser fusion targets. Leonard, T.A.; Cover, R.A. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *J. Appl. Phys.;* 50: No. 5, 3241-3246(May 1979).

An electro-optic streak camera was used to record $2\omega_0$ and (3/2) ω_0 harmonic emission from glass microsphere targets irradiated with a 0.3-TW Nd : glass laser. These two harmonic frequencies are produced at the critical and quarter-critical surfaces, respectively, and thus provide a measure of these electron-density trajectories. After applying a refraction correction to the data, the trajectories were compared with predictions from the KMSF TRHYD code. It was found that hydrodynamic development in the critical-density region was accurately depicted by the temporal behavior of the $2\omega_0$ emission. In addition, observed periodic fluctuations in (3/2) ω_0 emission along a meridian give direct evidence of density rippling in the underdense corona.

42479 Ultrahigh-pressure laser-driven shock-wave experiments in aluminum. Trainor, R.J.; Shaner, J.W.; Auerbach, J.M.; Holmes, N.C. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev. Lett.;* 42: No. 17, 1154-1157(23 Apr 1979).

We have measured the velocities of strong laser-driven shocks in aluminum. Pressures of 0.6 and 1.8 TPa were procuced by incident laser intensities of 8 x 10^{13} and 3 x 10^{14} W/cm^2. This is the first time that pressures this high have been inferred in a laboratory experiment.

BY-PRODUCTS

42480 (BNL—26130) **Advanced synfuel production with fusion.** Powell, J.R.; Fillo, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790803—26). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

An important first step in the synthesis of liquid and gaseous fuels is the production of hydrogen. Thermonuclear fusion offers a nearly inexhaustible source of energy for the production of hydrogen from water. Depending on design, electric generation efficiencies of ~ 40 to 60% and hydrogen production efficiencies by high temperature electrolysis of ~ 50 to 70% are projected for fusion reactors using high temperature blankets.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 43246

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

42481 (ORNL/TM—6710) **Stable isotope customer list and summary of shipments - FY 1978.** Davis, W.C. (comp.). (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

This compilation is divided into four sections: alphabetical lists of customers, of isotopes (cross-referenced to customer numbers), and of states and countries (cross-referenced to customer numbers), and a tabulation of the shipments of each isotope. (DLC)

PHYSICAL ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 44143

42482 Chemical and biochemical applications of lasers, Volume 3, 1977. Moore, C.B. (ed.). New York, NY; Academic Press (1977). 325p.

This book is intended to serve both as an introduction to selective photophysical and photochemical processes and as a review of current research. Fundamental principles and methods are described. For each of eight classes of laser methods, isotopic separations and related research, as well as applications of these selective techniques in chemistry, biology, and materials science, are discussed. A thorough description of the experimental results on multiphoton infrared processes and their theoretical interpretation is given. 489 refs.

RADIATION SOURCES

OTHER INDUSTRIAL USES

42483 Electrical charging of macroscopic particles using a beta source and electric and magnetic fields. Fjeld, R.A. (Texas A and M Univ., College Station); Heinsohn, R.J.; Levine, S.H. *Nucl. Technol.;* **43**: No. 1, 109-118(Apr 1979).

A theoretical and experimental study of an aerosol particle charging apparatus that utilizes a 407-MBq (11-mCi) ^{90}Sr—^{90}Y beta source and electric and magnetic fields has been performed. Fluid models of electron trajectories in the presence of the magnetic field, ion generation due to electron energy deposition, and particle charge acquisition due to ion transport are developed and applied to the experimental apparatus. Calculated average axial ion generation rates on the order of $10^{14}/m^3$ s are confirmed by experimental measurements, and calculated radial profiles are in good agreement with experiments. Calculated and experimental charging rates agree within 30% for 50- to 100-μm-dia glass spheres in an electric field of 100 kV/m and a magnetic field of 0.141 T. It is found that both the magnitude and spatial distribution of the ion generation rate play important roles in determining the rate of charge acquisition by an aerosol particle in a partially ionized gas subjected to an external electric field.

ISOTOPIC POWER SUPPLIES

DESIGN AND FABRICATION

42484 (COO—2764-002) **Demonstration of a free piston Stirling engine driven linear alternator system. Annual report.** (Mechanical Technology, Inc., Latham, NY (USA)). 1 Sep 1978. Contract EY-76-C-02-2764. 126p. Dep. NTIS, PC A07/MF A01.

The objective of the program is to develop a 2 kW Free Piston Stirling Engine/Linear Alternator Energy Conversion System for an isotopic heat source with a greater than 30% overall efficiency. The work was broken up into two phases. Phase I demonstrated the feasibility of the energy conversion system through analysis and experimental testing of the individual components. Phase II is a two-year effort to design, fabricate, and test a prototype demonstrator energy conversion system. The reprt documents the work performed during October 1976 through September 1977, the first year of Phase II. Details of the tasks are presented in five major sections: (1) Linear Alternator Development; (2) Engine/Alternator System Demonstration; (3) Demonstrator Preliminary Design; (4) Demonstrator Detailed Design; and (5) Development of Free Piston Stirling Engine Computer Simulation. (TFD)

42485 (DPST—78-128-9/10) **^{238}Pu fuel form processes, September—October 1978.** (Savannah River Ecology Lab., Aiken, SC (USA)). 1978. Contract EY-76-C-09-0001. 24p. Dep. NTIS, PC A02/MF A01.

Comparison of the process conditions and microstructural features of PuFF preproduction Spheres 13 and 15 indicates that the combination of greater hot press loading rate and increased PuO_2 content of Sphere 15 adversely affected microstructure and caused densification and increased cracking. Microstructure and cracking of $^{238}PuO_2$ pellets made in the PuFF parametric experiment are described. Pellet densities measured from micrographs and statistically correlated with process parameters were very sensitive to hot pressing load and moderately sensitive to feed powder particle size and hot pressing temperature.

42486 (LA—7868-PR) **General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program for April 1979.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 52p. Dep. NTIS, PC A04/MF A01.

The formal monthly report covers the studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of the Los Alamos Scientific Laboratory. The three programs involved are: general-purpose heat source development; space nuclear safety; and radioisotopic terrestrial safety.

42487 (N—79-11476) **Design and fabrication of the mini-Brayton recuperator (MBR). Final report, Mar 1974—Jul 1978.** Killackey, J.J.; Graves, R.; Mosinskis, G. (AiResearch Mfg. Co., Torrance, CA (USA)). Apr 1978. Contract NAS3-18029. 99p. NTIS PC A05/MF A01.

Development of a recuperator for a 2.0 kW closed Brayton space power system is described. The plate-fin heat exchanger is fabricated entirely from Hastelloy X and is designed for 10 years continuous operation at 1000 K (1300 F) with a Xenon-helium working fluid. Special design provisions assure uniform flow distribution, crucial for meeting 0.975 temperature effectiveness. Low-cycle fatigue, resulting from repeated startup and shutdown cycles, was identified as the most critical structural design problem. It is predicted that the unit has a minimum fatigue life of 220 cycles. This is in excess of the BIPS requirement of 100 cycles. Heat transfer performance and thermal cycle testing with air, using a prototype unit, verified that all design objectives can be met.

42488 (PNL—1845-42) **Quarterly report on the strontium heat source development program, Advanced Systems and Materials Production Division for January—March 1979.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 14p. Dep. NTIS, PC A02/MF A01.

Sectioning of the WESF $^{90}SrF_2$ capsule held at 800°C for one year was completed. Ring sections cut from the Hastelloy C-276 inner capsule will be shipped to ORNL for examination. Design of the prototype outer capsule has been completed. The design calls for a capsule having a 0.5-in. wall thickness. An order has been placed with Cabot Corporation to supply the materials for the prototype outer capsules and to fabricate the capsule parts. Delivery of the capsule components is scheduled for July of this year. Tests lasting up to 10,000 hr and measuring the rate of oxidation of Hastelloy S and Hastelloy C-4 in air at 600° to 800°C have been completed. Specimens oxidized for 5000 to 10,000 hr exhibited erratic oxidation behavior, apparently because of spalling of the oxide layer. Hastelloy S and Hastelloy C-4 specimens exposed to flowing seawater for 7500 hr suffered very little corrosion. Some isolated pitting to a depth of 0.1 mils was evident in the 7500-hr specimens. The corrosion, however, had no significant effect upon the room-temperature tensile properties of the two alloys.

HYDROGEN

42489 Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979). 682p. (CONF-780748—). $60.00.

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

Indivivual papers were entered into the data base. (LK)

42490 DOE program on hydrogen energy systems. Swisher, J.H. (Dept. of Energy, Washington, DC). pp 645-671 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

The Department of Energy (DOE) hydrogen budget, hydrogen programs in the Division of Energy Storage Systems, and other hydrogen-related research at DOE are discussed.

PRODUCTION

REFER ALSO TO CITATION(S) 42480, 43142

ELECTROLYSIS

REFER ALSO TO CITATION(S) 42495

42491 **Hydrogen from falling water.** Palumbo, J. pp 393-398 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

Topics discussed are: resource base; falling water to shaft power subsystem; shaft power to electricity subsystems; electricity to hydrogen subsystem; parametric cost analysis; and falling-water hydrogen for regional use. The conclusion was reached that hydrogen does appear to have identifiable an immediate benefits as an alternative means of harnessing the energy of existing small falling-water sites as a means of displacing usage of natural gas for producing merchant hydrogen.

THERMOCHEMICAL PROCESSES

42492 (LA-UR—79-1256) **Process design of the LASL Bismuth Sulfate thermochemical hydrogen cycle.** Cox, K.E.; Pendergrass, J.H.; Jones, W.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790803—25). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A new process engineering flowsheet reflecting an improved design of the LASL Bismuth Sulfate thermochemical cycle is presented. The design is based on laboratory data that indicate a lowered endothermic heat load for a partial decomposition of the solid bismuth sulfate. A small electrical energy demand should result from operation of the sulfur dioxide electrolytic step at lower acid concentration, in principle. The results of the flowsheeting analysis yield a thermal efficiency of 50% for the cycle when coupled to a conceptual fusion energy heat source at 1500°K. A parametric analysis shows a slight drop in efficiency as the temperature of the heat source is decreased. The LASL Bismuth Sulfate thermochemical cycle appears to have potential as a means of producing hydrogen from high-temperature heat sources such as fusion, fission, and solar energy; it also appears to be competitive with alternative thermochemical cycles as well as with water electrolysis for hydrogen production.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 42642

42493 (DFVLR-FB—78-17) **Photolytic decomposition of water into oygen and hydrogen as an alternative energy utilization of households and small consumers.** Wendekamm, W.U. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Hardthausen (Germany, F.R.). Inst. fuer Chemische Antriebe und Verfahrenstechnik). 1978. 47p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

The photolytic decomposition of water into oxygen and hydrogen is one of the possible alternatives of the transformation of solar energy into storable secondary energy for practical utiliztion in the consumption sectors households and small consumers. After a survey of the possible cycles of water decomposition, the chemical and physical fundamentals of the photolytic decomposition of water using inorganic catalysts and sensitizers are described. Finally, a total house energy supply system is presented as one illustration of the application possibilities.

42494 (PB—287508) **Photoproduction of hydrogen by marine blue-green algae. Annual progress report 15 Dec 77-15 Jun 78.** Mitsui, A. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 15 Jun 1978. 71p. NTIS PC A04/MF A01.

Addressed is the biological and biochemical photoproduction of hydrogen for use as an alternate fuel. Earlier investigations found an organism which exhibits exceptionally high hydrogen producing capabilities in the form of a blue-green algal strain, Miami BG7. Further studies were performed to reveal the mechanisms of hydrogen production in this strain and to determine whether the efficiency of hydrogen production can attain levels required for applied projects. Emphasis in research shifted from the study of metabolic inhibitors of hydrogen production to a study of the enzyme systems which catalyze hydrogen production. In Phase I it was discovered that hydrogen evolution by Miami BG7 involves the participation of both hydrogenase and nitrogenase, with the latter appearing as the major contributor of the hydrogen production. However, Miami BG7 does not appear to exhibit hydrogenase activity. Phase II was based on the environmental regulation and enhancement of hydrogen photoproduction by Miami BG7. The effects of light intensity, temperature, and pH were tested and optimum conditions for hydrogen photoproduction were determined. It was found that the regulation of specific environmental parameters could lead to marked changes in the quantum efficiency of hydrogen production. For purposes of reference, a brief background review and discussion of hydrogen photoproduction is given with the author's approach to hydrogen production research.

42495 **Concepts for solar production of hydrogen.** Handon, J.A. (Jet Propulsion Lab., Pasadena, CA). pp 361-392 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

This presentation surveys thirteen basic technical approaches to producing hydrogen from solar energy. Solar energy forms are divided into; (1) direct solar radiation and (2) indirect forms such as wind and the ocean thermal gradient. Technical approaches are separated into; (1) direct hydrogen production from the action of sunlight on some substrate, (2) hydrogen production from sunlight via an intermediate form of energy such as heat and electricity, and (3) hydrogen production from indirect solar energy via an intermediate energy form. The survey is necessarily general and avoids technical detail. Generally, hydrogen from solar energy will be expensive by today's standards until some major cost reducing advances are made in one or more of the approaches presented here. However, as fossil fuels of all types are depleted, solar hydrogen begins to emerge as only one of two apparent alternative to a nuclear-electric or a nuclear-electric-hydrogen energy system.

COAL GASIFICATION

42496 (FE—2855-3) **Catalytic conversion of coal energy to hydrogen. Project quarterly report, May 4—July 31, 1978.** Starkovich, J.A. (TRW, Inc., Redondo Beach, CA (USA)). Aug 1978. Contract ET-78-C-01-2855. 37p. Dep. NTIS, PC A03/MF A01.

The overall objective of this program is to develop a preliminary assessment of the potential of an advanced gasification process based upon char, steam, lime and metal salt additives and catalyzed carbon, oxygen, and steam reactions. Work was initiated on restoring the 2.5-cm-diam, pressure fluid bed reactor system. Some modifications to the system were made in order to make operation of the system more flexible and efficient, and to solve particulate carryover problems. The char screening study effort was planned. A new fixed bed reactor was designed, constructed and preliminarly checked out. A preliminary study of the effects which major process parameters have on hydrogen product costs was undertaken for the conceptual, catalytic hydrogen process design developed under the previous contract. The eight parameters selected for study were: reaction extent in the hydrogen production reactor, shift converter catalyst selection and operation temperature, catalyst recyclability performance, steam utilization rate in the hydrogen production reactor, gasifier and acceptor regenerator residence times, gasifier and acceptor regenerator operational temperature, acceptor activity, and energy recovery from the spent solids bleed stream. (LK)

STORAGE

CHEMISORPTION

REFER ALSO TO CITATION(S) 43412

42497 (BNL—26047) **Metal hydride technology.** Reilly, J.J. (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 60p. (CONF-790301—10). Dep. NTIS, PC A04/MF A01.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

A promising alternative for hydrogen storage is storage as a metal hydride. The properties and applications of those systems which have proven or potential utility as hydrogen storage compounds are summarized. Specific systems discussed are magnesium alloy hydrides, iron-titanium alloys, titanium-chromium alloys, and rare earth alloys. (LK)

TRANSPORT

42498 **Hydrogen and alternative means of energy delivery from ocean thermal energy conversion (OTEC) plants.** Talib, A.; Konopka, A.; Biederman, N.; Blazek, C.; Yudow, B. (Inst. of Gas Tech., Chicago, IL). pp 399-437 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

The alternative forms of energy transmission from ocean thermal energy conversion (OTEC) plants are compared. The chemical energy carriers considered are: gaseous liquid hydrogen, liquid ammonia, methanol, gasoline, and methane. The assessment assumes that each of the above energy carriers were transported by

barge and/or pipeline. The delivered costs of energy using the above chemical energy carriers are compared for different offshore distances. When comparing the delivered cost of chemical energy with transmission of electricity by submarine cables, the outputs are converted to a common form. Thus, in addition to presenting the production and transportation costs and overall energy efficiency of the chemical energy carriers, we have provided a discussion of the equipment, capital and operating costs, and efficiencies of converting the delivered hydrogen and ammonia into electricity. As such, this paper provides a concise technical assessment and economic analysis of components associated with the conversion, storage, transportation, and shore-based receiving facilities for the conversion of OTEC mechanical energy to chemical energy, and in some cases conversion of delivered chemical energy to electricity. Results concerning the hydrogen and ammonia analysis were determined as part of the OTEC program at IGT from May 1975 through May 1976 under Contract No. NSF-C-1008 (AER-75-00033) with the National Science Foundation and ERDA. Information concerning carbonaceous fuels was developed as part of the IGT OTEC program under Contract No. E(49-18)-2426.

42499 Transmission of gaseous hydrogen: a preliminary technology evaluation. Robinson, S.L. (Sandia Labs., Livermore, CA). pp 453-483 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

Hydrogen embrittlement phenomena are discussed, and their implications for hydrogen transmission by pipeline are explored. Metallurgical trends in pipe steels are considered for their effect on hydrogen embrittlement. Burst testing of internally flawed A106-B pipe showed a 15% loss in hoop stress at failure when pressurized with 1000 psi hydrogen. Therefore, pressure derating of pipelines for hydrogen transmission compared to natural gas may be necessary for equivalent safety margins. Fracture toughness testing using J-integral techniques shows a 40% loss of toughness compared to the 15 to 17% loss predicted from burst tests. A satisfactory laboratory test to predict the effect of hydrogen in full scale tests does not yet exist, but would be valuable.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 42498, 42502

SAFETY

42500 (COO—4442-4) Compilation and analysis of hydrogen accident reports. Final technical report. Zalosh, R.G.; Short, T.P. (Factory Mutual Research Corp., Norwood, MA (USA)). Oct 1978. Contract EE-77-C-02-4442. 142p. Dep. NTIS, PC A07/MF A01.

Over 400 reports of accidents involving hydrogen have been collected from a variety of sources including insurance companies, government agencies, trade associations, fire protection associations, and individual companies using hydrogen. Most of the accidents occurred in industrial facilities in the period 1965—1977. Representative case histories and tabulations of the data according to the causes and contributing factors are presented. The data indicate that hydrogen explosions have been a more serious problem than other types of hydrogen accidents in terms of the number of incidents, casualties, and reported property damage. Many of the explosions have resulted from undetected accumulations of hydrogen due to leaks, inadequate purging, inadequate ventilation, and obstructed vent systems. Statistical comparisons of hydrogen and natural gas accident data are conducted for the few situations in which there are comparable operating modes and occupancies. Based on the limited data currently available, the comparisons do not reveal any conclusive, statistically significant differences that would preclude future widespread use of hydrogen with a safety record comparable to that of natural gas today. The need for special fire and explosion protection measures because of flammability differences between hydrogen and conventional fuels has been reflected in the accident data.Recommendations are presented for improving hydrogen fire/explosion protection technology in the areas of hydrogen detection, emergency high-speed pressure relief devices, and explosion venting.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 42838

42501 Development of ventless appliances and a catalytic ignition system. Johnson, D.G.; Jasionowski, W.J.; Pangborn, J.B.; Scott, M.I. Chicago, IL; Institute of Gas Technology (1979). 17p. (CONF-790337—1).

From New fuels and advances in combustion technologies symposium; New Orleans, LA, USA (26 Mar 1979).

During 1972—1976, IGT invented and developed designs for several appliances that employ catalytic burners for combustion of hydrogen rich gases, and fabricated bench-scale models for performance and emission testing. These model catalytic appliances operate very efficiently at low combustion temperatures and produce very low emissions of nitrogen oxides. Because of the low emission levels, outside venting of the products of combustion would not be required (i.e., ventless operation). Initiated in 1974 as an offshoot of the ventless appliance program, IGT invented and has been developing an instantaneous ignition system for conventional gas appliances. Hydrogen, stored in the form of a metal hydride, is used as the ignition fuel. In operation, a small quantity of hydrogen is released by valving and instantaneously ignited in air from a platinum catalyst. This catalytic ignition system could become a less expensive alternative to the electronic ignition systems that have been developed to replace the standing gas pilot. This paper describes these various inventions, their state of development, and prospects for the future.

42502 Demand and supply of hydrogen as chemical feedstock in USA. Huang, C.J. (Univ. of Houston, TX); Tang, K.; Kelley, J.H.; Berger, B.J. pp 69-84 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

Projections are made for the demand and supply of hydrogen as chemical feedstock in USA. Industrial sectors considered are petroleum refining, ammonia synthesis, methanol production, isocyanate manufacture, edible oil processing, coal liquefaction, fuel cell electricity generation, and direct iron reduction. Presently, almost all the hydrogen required is produced by reforming of natural gas or petroleum fractions. Specific needs and emphases are recommended for future research and development to produce hydrogen from other sources to meet the requirements of these industrial sectors. The data and the recommendations summarized in this paper are based on the Workshop "Supply and Demand of Hydrogen as Chemical Feedstock" held at the University of Houston on December 12—14, 1977.

42503 Hydrogen: potential key to tomorrow's energy utility. Lundberg, R.M. pp 583-587 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

The Electric Utility faces an ever increasing cost of plant and fuel which is expected to accelerate at a greater rate than the economy. This incentive to use fuel more efficiently, directs utility investments to more sophisticated technology which at present requires fuel processing. Such fuel processing creates a demand for hydrogen and the expected decline of natural gas creates further demands for hydrogen as igintion fuel, or to further process coal to peaking fuel.

PROPERTIES

REFER ALSO TO CITATION(S) 42499

42504 Calculations of potential energy curves for the ground states of NaH^+ and KH^+ and II states of NaH and KH. Melius, C.F.; Numrich, R.W.; Truhlar, D.G. (Sandia Labs., Livermore, CA). *J. Phys. Chem.;* **83**: No. 9, 1221-1227(3 May 1979).

Calculations of diatomic potential energy curves calculated by using two different kinds of effective core potentials are presented. The curves studied are the ground states of NaH^+ and KH^+ and the lowest $^3\Pi$ and $^1\Pi$ states of NaH and KH. The two methods yield qualitatively similar but quantitatively different results. The best values calculated for the potential well depths and positions for NaH^+ and KH^+ are 0.06 and 0.02 eV and $5.1a_0$ and $6.5a_0$, respectively. Both methods predict that the potential curves of the II states of the neutrals are qualitatively similar to the potential curves of the ground states of the ions.

42505 Designing to minimize hydrogen embrittlement. Louthan, M.R. Jr.; McNitt, R.P.; Sudarshan, T.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 439-452 of Hydrogen for energy distribution. Chicago, IL; Institute of Gas Technology (1979).

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

Some implications of the roles of stress state, loading rates and type of hydrogen exposure in energy storage and transmission systems are examined. Difficulties inherent in extrapolation of embrittlement data from particular laboratory loading and environ-

ments to system components subjected to quite different loading and environments are discussed. A series of experiments designed to compare the hydrogen compatability ot two steels, A106 and 4340, is described and the results are discussed as to hydrogen system design considerations. The experiments include: uniaxial loading at various low strain rates while exposed to several gaseous environments at different pressures, delayed failure of specimens loaded in either a biaxial or uniaxial stress state while immersed in high pressure hydrogen, low cycle fatigue in different gas environments, burst tests in hydrogen, bending and torsional high cycle fatique with hydrogen precharged specimens, and delayed failure of pressure vessels loaded to either a cylindrical or spherical stress state. The results are indicative of the inherent difficulties in qualifying a material on the basis of only one type test.

OTHER SYNTHETIC AND NATURAL FUELS

42506 (EPRI-AF—1036-SY) **Executive summary: workshop on biomass energy and technology. Final report.** Stegen, G.R. (Science Applications, Inc., Bellevue, WA (USA)). Mar 1979. 31p. Dep. NTIS, PC A03/MF A01.

This Executive Summary presents an overview of the presentations and contributions by participants in the Workshop on Biomass Energy and Technology. The workshop, jointly sponsored by the Electric Power Research Institute and the Gas Research Institute, was held November 8—9, 1978, in Santa Clara, California. The objectives of the workshop focused on: acquainting the electric and gas utility industries with recent results relating to biomass production and utilization; and assessing their level of interest in producing fuels and energy from biomass. Two working groups presented responses to the workshop sponsors; these groups concluded that availability of biomass resources at acceptable cost limited the present use of biomass resources by utilities. Furthermore, the combination of continued fundamental research and the development of reliable technical design criteria should be the goal of utility research institutions. A greater awareness of the scope and direction that biomass energy program efforts might take at EPRI and GRI was facilitated through the interaction of the participatnts from the academic, governmental, and industrial communities.

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 43185

PROPERTIES

REFER ALSO TO CITATION(S) 42498, 43528

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 43526, 43529

42507 (COO—4691-1) **Screening of zeolite catalysts for methanol conversion to light hydrocarbons. Final report, January 1—September 30, 1978.** Cobb, J.T. Jr.; Coon, V.T.; Tipnis, P. (Pittsburgh Univ., PA (USA)). Sep 1978. Contract EW-78-S-02-4691. 36p. Dep. NTIS, PC A03/MF A01.

Eleven tests were performed in the CTU with Zeolon 500 (chabazite) and lanthanum-exchanged Zeolon 500. During the first 200 to 800 minutes of each test, catalyst performance was examined. The independent variables explored were extent of lanthanum exchange, temperature, space velocity, and short-term aging. Selectivity was greatly affected by aging with paraffins being the major product in the first few minutes, olefins being present at intermediate times, and dimethyl ether being the major product toward the end of the study period in each test. At higher temperatures the rate of aging decreased, the maximum olefins produced increased, and the production of dimethyl ether decreased. Lanthanum exchange had little effect on catalyst performance. Data collected at different space velocities were correlated with a second order conversion model and a linear deactivation model. Reasonably consistent plots of activity and deactivation rate constant were obtained. Eleven catalyst samples from several of the CTU tests were analyzed for carbon content by standard techniques and for structural features by powder X-ray diffraction. Aged samples contained about 10% carbon. Fresh samples and samples regenerated once showed 0.1% carbon and similar X-ray patterns. One sample, aged and regenerated ten times, showed a loss of 80% of its structural features.

42508 (FE—2276-21) **Development studies on selected conversion of synthesis gas from coal to high octane gasoline. Quarterly report, January—March 1978.** Brennan, J.A. (Mobil Research and Development Corp., Paulsboro, NJ (USA); Mobil Research and Development Corp., Princeton, NJ (USA)). Apr 1978. Contract EX-76-C-01-2276. 63p. Dep. NTIS, PC A04/MF A01.

Mild oxidative and hydrogenative regeneration studies with developmental catalyst SG-A-3 have continued in the micro reactor units. Activation and oxygen regeneration of catalyst SG-A-4 have also been studied. Extended aging of catalysts designed to produce equilibrium mixtures of methanol-dimethylether has been completed. Flow studies in the plexiglass model of the fluid bench-scale unit indicate that catalyst slugging may be responsible for the high temperatures in the reactor catalyst disengager zone associated with recent SGF-A-3 performance. The Mobil proprietary catalyst research effort has provided seven developmental catalysts for the contract process studies.

42509 (LBL—8975, pp 11-14) **Heterogeneous catalytic processes involving methane.** Yates, J.T. Jr.; Madey, T.E.; Goodman, D.W.; Kelley, R.D. (National Bureau of Standards, Washington, DC). Feb 1979.

In Heterogeneous catalysis research meeting.

42510 (LBL—8975, pp 20-21) **Thermodynamics of sulfur adsorbates on metal catalyst surfaces.** McCarty, J.G.; Wise, H. (SRI International, Menlo Park, CA). Feb 1979.

In Heterogeneous catalysis research meeting.

42511 (LBL—8975, pp 47-48) **Catalyzed hydrogenation of carbon monoxide.** Somorjai, G.A. (Univ. of California, Berkeley). Feb 1979.

In Heterogeneous catalysis research meeting.

42512 **Studies of CO desorption and reaction with H_2 on alumina-supported Ru.** Low, G.G.; Bell, A.T. (Univ. of California, Berkeley). *J. Catal.;* **57**: No. 3, 397-405(May 1979).

The temperature-programmed desorption (TPD) of CO and temperature-programmed reaction (TPR) of chemisorbed CO in H_2 have been studied on a Ru/Al_2O_3 catalyst. Adsorption at 303 K occurs molecularly and leads to the observation of two peaks in the TPD spectrum. The activation energies associated with these peaks are 27 and 37 kcal/mole. Upon heating above 415 K CO disproportionation takes place, forming CO_2 and carbon. The carbon deposited on the catalyst surface readily reacts with H_2 at 303 K to produce methane and ethane. These products are also formed during TPR of chemisorbed CO. The mechanism of CO disproportionation, the effect of surface carbon on the bonding of chemisorbed CO, and the reactions of chemisorbed CO with H_2 are discussed.

42513 **Kinetics of the methanation reaction over Ru, Ru—Ni, Ru—Cu, and Ni clusters in Zeolite Y.** Elliott, D.J.; Lunsford, J.H. (Texas A & M Univ., College Station, TX). *J. Catal.;* **57**: No. 1, 11-26(30 Mar 1979).

Clusters of Ru, Ni, and a series of Ru—Ni and Ru—Cu bimetallies in a Y-type zeolite were investigated as catalysts for the reaction of CO with H_2 to form CH_4. Although the particle size of the Ru clusters indicates that they remained in the large cavities of the zeolite, the turnover numbers for several samples were in agreement with those observed for Ru/Al_2O_3. By contrast, the nickel clusters were located on the external surface of the zeolite, and the turnover number was more than an order of magnitude less than that observed for Ni/Al_2O_3. The presence of ruthenium in bimetallic clusters caused the average particle size to decrease significantly, relative to the values which were observed for pure nickel or pure copper. The turnover numbers for the Ru—Ni zeolites decreased linearly with respect to the addition of Ni, but the decrease in initial activity was much more severe upon addition of Cu to the RuY zeolite. The supported ruthenium catalysts exhibited a marked decline in activity during the reaction, but the addition of excess nickel (1:7 atomic ratio) brought about a stabilization in activity which even exceeded the stability of the supported Ni catalysts. The decrease in activity is attributed to the build-up of excess carbon which results from the dissociation of CO. The presence of Ni is believed to moderate the activity of ruthenium for this reaction, thus providing more sites for dissociative chemisorption of H_2.

42514 **SNG and industrial fuel gas.** Vorres, K.S. Chicago, IL; Inst. of Gas Tech. (1978). 29p. (CONF-7810160—1).

From Conference on the outlook for natural gas; Washington, DC, USA (30 Oct 1978).

Technologies exist for manufacture of SNG (substitute natural gas) and IFG (industrial fuel gas) from coal. The Lurgi technology is closest to being demonstrated for SNG in this country. The major immediate hurdles involve the regulatory process in seeking approval of a number of conditions which must be met to secure the tremendous amount of capital which is involved. More advanced technologies are potentially available. One will be selected soon for a demonstration plant which can later be scaled up to a full-size plant. Similarly, technology exists for production of IFG from coal. A demonstration plant will be built after a selection is made from these technologies. This approach will demonstrate the potential of a small number of processes over an extended period of time.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 42631, 42632, 42633

42515 (DOE-tr—184) **Serious management of biogas.** Mar 1979. Translation of Earnest effective management of marsh gas; Agricultural Press Publishing House, New China Bookstore, BeiJing Branch, Nov 1, 1975. 136p. Dep. NTIS, PC A07/MF A01.

A collection of 17 articles, translated from the Chinese, are compiled. They deal with the experiences of various Chinese provinces and regions in developing the use of biogas (methane and carbon dioxide mixture) obtained from the anaerobic digestion of domestic and agricultural wastes. Problems encountered and solutions found are indicated. The biogas is used for cooking and lighting purposes in Chinese farms and villages. Government policy in promoting its use is emphasized. (JSR)

PROPERTIES

REFER ALSO TO CITATION(S) 42498

PREPARATION

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 42508, 42631, 42632, 42633, 42634, 43815

42516 (TID—29400/2) **Sugar crops as a source of fuels. Volume II. Processing and conversion research. Final report.** Lipinsky, E.S.; Birkett, H.S.; Polack, J.A.; Atchison, J.E.; Kresovich, S.; McClure, T.A.; Lawhon, W.T. (Battelle Columbus Labs., OH (USA)). 31 Aug 1978. Contract W-7405-ENG-92-077. 315p. Dep. NTIS, PC A14/MF A01.

After a summary of the principal findings with respect to both the agricultural research reported in Volume I and processing and conversion research reported in the present volume, detailed discussions are presented on the following topics: processing of sugar crops for the manufacture of fermentable sugars, conversion of fermentable sugars into ethanol considered from both a technical and economic viewpoint, research and development implications of the technical and economic results. Appendices provide detailed equipment lists, materials and energy balances, and costs for the manufacture of ethanol from sugarcane and from molasses, using state-of-the-art technology. Ethanol from sugarcane or sweet sorghum is unlikely to be available in large quantities for less than $1.00 per gallon because improvements in sugar crop production and processing are needed to hold the raw material costs for ethanol to $0.70 per gallon. When reasonable provisions are made for fermentation, distillation and return on investments, the target of $1.00 per gallon appears appropriate. There are opportunities to manufacture liquid motor fuels other than ethanol from sugar crop juice and/or associated lignocellulosic fractions. Typical alternatives are 2,3-butanediol, ketones derived from short-chain fatty acids, and microbial oils.

42517 **Enzymatic hydrolysis of cellulose and simultaneous fermentation to alcohol.** Blotkamp, P.J.; Takagi, M.; Pemberton, M.S.; Emert, G.H. Merriam, KS; Gulf Oil Chemical Co. (1978). 6p. (CONF-780223—6).

From 84. AIChE national meeting; Atlanta, GA, USA (24 Feb 1978).

The simultaneous saccharification of cellulose and fermentation to ethanol, utilizing the cellulase enzymes of T. reesei and the yeast S. cerevisiae, has been shown to give increased rates of hydrolysis when compared to saccharification alone due to removal of competitive inhibition by glucose and cellubiose. The effect of increasing the concentrations of enzyme and substrate resulted in increased yields of ethanol while an increase in the size of the yeast inoculum had little effect on the yield. In addition, experiments indicate no inhibitory effect of the cellulase enzymes due to accumulation of ethanol in the reaction mixture.

42518 **PUROX System: solid waste to energy.** Donegan, T.A. (Union Carbide Corp., Tarrytown, NY). pp 293 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

PROPERTIES

REFER ALSO TO CITATION(S) 42498

PREPARATION

REFER ALSO TO CITATION(S) 42631, 42632, 42633

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 42631, 42632, 42633

42519 **What is refuse power.** Feindler, K.S. pp 287-290 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Refuse power is defined and its solid waste sources are described. New trends in refuse power plants, revenues from refuse power, and the conditions which favor refuse power plants are presented. (MHR)

HYDRO ENERGY

42520 (DOE/ET/01752—1) **Micro-hydro power: reviewing an old concept.** Alward, R.; Eisenbart, S.; Volkman, J. (National Center for Appropriate Technology, Butte, MT (USA)). 1 Jan 1979. Contract ET-78-S-07-1752. 67p. Dep. NTIS, PC A04/MF A01.

This informaion package has been prepared to respond to an increasing number of requests for information on micro-hydro systems. It contains a resource directory, which is an attempt to put the reader in contact with the literature, plans, people, and companies appropriate to needs. On a world-wide basis, small-scale, environmentally benign, mechanical, and electrical hydropower systems are common. These are the systems for individual homes, farm, and shop use and generally have power outputs less than 100 kW. For convenience in terminology, this scale of hydro power is referred to as micro-hydro. A decision tree is first presented followed by information on determining the suitability of th site, equipment, economics, sources for financial assistance, regulatory conflicts, cautions and suggestions for the Do-It-Yourselfer, and the Self-Installer, manufacturers and suppliers, and sources of professional services. An annotated bibliography of 16 references is provided. (MCW)

RESOURCES AND AVAILABILITY

42521 **Status of small-hydropower studies in New York State.** Brown, R.S. (Polytechnic Inst. of New York, Brooklyn); Napoli, R.; Goodman, A.S.; Thatcher, L. pp 177-185 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Interest in the Northeast is growing, in spite of institutional barriers, for redeveloping small hydro sites. A number of private developers as well as individual site owners are moving to take advantage of DOE programs and congressional initiatives. The heightened interest of both government and private individuals is mutually reenforcing. Small-scale hydropower redevelopment may have only a small impact on a state's overall energy production, but its impact on the locality in which it is sited can be significant. This is especially true if the redeveloped project attracts new industry or provides power for the municipality's own use, thus lowering governmental costs to local taxpayers. The impact of a number of small sites is, in a sense, greater than the impact of the whole.

42522 Recommendations from completion report of low-head/small hydroelectric workshop. pp 187-205 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

From Low-head/small hydroelectric workshop; Durham, NH (6 Sep 1977).

Recommendations made by participants at the 1977 Low-Head/Small Hydroelectric Workshop are summarized under the six panel categories: (1) Resource Assessment, (2) Engineering Development, (3) Institutional and Legal, (4) Environment and Safety, (5) Economics and marketability, and (6) Demonstrations. Both general and specific recombinations are included. An overall program to assess potential sites, reduce economic, environmental, and institutional barriers, and to proceed with data analysis and demonstration emerges. The parameters of major recommendations are documented in terms of the time frame, cost, and Federal role anticipated for the research, development, and demonstration phases of each plan.

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 42532

PLANT DESIGN AND OPERATION

42523 (DOE/ID/01783—1) **Lower Main Canal hydro stations. Feasibility assessment report.** (CH2M Hill, Sacramento, CA (USA)). Nov 1978. Contract EW-78-F-07-1783. 90p. Dep. NTIS, PC A05/MF A01.

A feasibility assessment of small hydroelectric powerplants on the MID Lower Main Canal at Modesto Reservoir and Stone Drop is presented. Included are results of analyses covering alternative layouts for civil works and alternative turbine-generator units. The analyses were conducted at a feasibility level as were quantity takeoffs and construction cost estimates. This evaluation indicates that it is technically feasible to construct powerplants at the Modesto Reservoir and Stone Drop sites.

42524 James Bay Project: style on the face of the Taiga. *World Water;* **1**: No. 6, 23-26, 29-31(Oct 1978).

Construction activities, the logistic problems, provisions for caring for workers' needs, and the current status of the James Bay Project for constructing four hydro power plants on the La Grande River system in Quebec are described. (LCL)

42525 Operation of a hydro power set in an isolated network with a speed controller linked to voltage controller. Kowalik, T.; Smoczynska, U. *Energetyka;* **32**: No. 6, 232-236(Jun 1978). (In Polish).

A novel concept of linking the turbine speed controller with the generator's voltage controller to get hydro power set's output power dependent on the speed when the set operates in an isolated network is described. Results of calculation of the transient processes when the new control circuit was in operation and an abrupt change in load of different magnitude was applied. The dynamic properties of the hydro power set are improved with the new circuit.

REGULATIONS AND LICENSING

42526 (DOE/RA—23-216.00.0-01) **Preliminary analysis of legal obstacles and incentives to the development of low-head hydroelectric power in the Northeastern United States.** Brown, P.W.; Buxton, A.W. (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). 12 Mar 1979. 83p. Dep. NTIS, PC A05/MF A01.

This report presents a preliminary analysis of the legal obstacles and incentives to the development of the low-head hydroelectric potential of the nineteen states making up the northeastern quandrant of the U.S. The intended subject matters of the report are the statutes and case laws of the nineteen states and the Federal government which affect developers of small dams. The actual subject matters of this report are the legal uncertainty which confronts the developer of small dams and the regulatory burden to which the developer may be subjected once the uncertainty is resolved. The objective has been to locate and describe the laws and doctrines which directly or indirectly affect developers of small dams. The report reaches no final conclusion concerning the nature or impact of any particular law or doctrine on the developer of small dams. For ease of analysis, the mythical State of Hydrovania is described and its regulatory and legal systems analyzed.

42527 Some problems facing low-head development. Allred, C.S. (Idaho Dept. of Water Resources, Boise). pp 30-32 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Idaho, which has already built high-head dams because of their economies of scale, is finding some problems associated with low-head hydro projects. Most problems involve people who would be asked to change existing facility use, alter water rights, and accept other parties in their system. Authority and funding for low-head sites are not clearly defined, although the state legislature is beginning to examine the problems. Other difficulties involve bureaucratic red tape and fragmented decision-making. A mechanism is suggested for consolidating sponsors and projects into a coordinated effort to secure the data and financing needed to overcome these problems rather than waiting until a crisis atmosphere develops over energy supplies.

42528 Small-scale hydro development: institutional and legal problems. Corso, R.A. (Federal Energy Regulatory Commission, Washington, DC). pp 115-123 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The problems facing a potential developer of small-scale hydroelectric power seeking to obtain Federal approvals are examined. The procedures for determining jurisdictional status of a project are complex and can be approached by different routes. The legal steps for dealing with competing private and public entities and to obtain licensing are described and illustrated by an accompanying flow chart. Small-scale projects, it is pointed out, seldom involve the kind of issues that lead to serious license delays. The list of statutes affecting licensing, and one which increases at the rate of one new bill a year, cover fish and game facilities, endangered species, and Federal lands among others. FERC's goal is to simplify and reduce the number of steps required to license a small-scale hydro project. This is a step that will require the cooperation of the states and developers to be successful.

42529 Federal legislative considerations. Viessman, W. Jr. (Library of Congress, Washington, DC). pp 124-128 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

Federal interest has increased in small-scale hydro facilities following a Corps of Engineers evaluation that predicted hydroelectric capacity can be doubled by improving existing sites and developing new ones on minor rivers and tributaries. Technical feasibility already exists, but so many economic, environmental, and institutional constraints hamper the licensing of hydroelectric facilities that a 20-year time lag is possible. The Federal Energy Regulatory Commission (FERC) has identified the delaying factors as construction schedules, labor availability, environmental impacts, system-wide effects, and the multi-purpose nature of most small hydro projects. Congress now recognizes the need to develop an integrated system of policies and financial incentives and to remove as many barriers as possible. Several related socio-economic and technological factors are listed which affect the future of small-scale hydro development. 6 references.

42530 Lawyer's view. Rosholt, J.A. (Parry, Robertson, Daly and Larson, Twin Falls, ID). pp 133-135 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The legal and institutional requirements for developing low-head hydro power are a major factor in the costs of small projects. The costs of acquiring a Federal power license, the problems of shared jurisdiction when power generation is combined with water projects, and the costs of operating the plant and marketing power must all be built into the feasibility studies. Amendments to the tax laws are suggested to allow power generation by nonprofit corporations and irrigation districts. Licensing requirements could also be waived for projects of 15,000 kilowatts or less. State laws need to be amended and made more flexible to encourage the development of hydro sites. A checklist of required permissions is followed by a list of legislative actions that could remove some of the constraints.

42531 Woodruff Narrows example. Hoggan, D.H.; Porter, R.B. (Utah State Univ., Logan). pp 136-141 of Low head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The Woodruff Narrows Dam on Bear River illustrates some of the legal and institutional problems associated with hydroelectric power projects. The project involves appropriative water rights, with a tri-state compact apportioning direct flow of water to Idaho, Utah, and Wyoming, and competition among the states for an increased share. The dam and reservoir, originally planned for irrigation, could be expanded with the construction of a power plant and not disrupt the flow patterns. A number of alternative configura-

tions are possible, but each would have different legal and institutional implications for the interstate compacts and approvals by Federal, state, and local agencies. If a state becomes the developer and operator, it must meet the same Federal and state requirements as a private developer. The unavailability of dam liability insurance and long-term restriction on borrowing need to be changed.

ECONOMICS AND MANAGEMENT

REFER ALSO TO CITATION(S) 42530

42532 (DOE/ID/1775—1) **Proposed redevelopment Kimberly Clark Corporation Vulcan Hydroelectric Project on the Fox River at Appleton, Wisconsin.** (Mead and Hunt, Inc., Madison, WI (USA)). Jan 1979. Contract EW-78-F-07-1775. 45p. Dep. NTIS, PC A03/MF A01.

The feasibility of installing a hydroelectric power plant at the Vulcan site on the Fox River in Wisconsin was assessed. Information is included on available water power, proposed plant design and performance, market for generated power, environmental effects, and regulatory aspects. It was concluded that the plant should have an installed capacity of 2200 kW using two units, the cost is estimated at $3.36 million, there would be no adverse environmental effects nor safety hazards, the site is suitable, and units could be on line 18 months after starting the design. (LCL)

42533 **Low-head hydro and the energy problem.** Clapp, N.M. (Development and Resources Corp., New York, NY). pp 25-29 of Low-head hydro: an examination of an alternative energy source. Gladwell, J.S.; Warnick, C.C. (comps.). Moscow, ID; Idaho Water Resources Research Inst. (1978).

The role of low-head hydro power is examined in light of the energy needed to provide an acceptabe standard and quality to life for an expanding population and to support economic growth. A projected electric power load growth of 5.5 percent is felt to be unrealistic if national policies force industry to shift to coal, which industry will want in the form of electric power so industrial plants can meet environmental regulations. No single source can provide all needed energy, but a vigorous pursuit of low-head hydro can make a significant contribution. If institutional and financial barriers can be lifted, low-head hydro offers a proven technology and is rapidly becoming economically feasible. Leadership is needed from the government for funding and to simplify licensing, from the utilities to integrate low-head hydro into their systems, and from the public to understand and support the concept.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 43839

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 43143, 43144

SOLAR ENERGY

REFER ALSO TO CITATION(S) 43245, 43251

42534 (TAC-STPG—78-002) **Solar thermal power generation. Quarterly update, April—June 1978. Bibliography with abstracts.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. 245p. Technology Application Center, Univ. of New Mexico, Albuquerque, NM.

Citations are presented on the following subjects: energy overviews; solar overviews; conservation; economics, law; thermal power; thermionic, thermoelectric; ocean; wind power; biomass; and large photovoltaics. Author and permuted titles/keywords are included. (MHR)

42535 (TAC-STPG—78-003) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, July—September 1978.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jan 1979. 137p. Univ. of New Mexico, Albuquerque, NM.

This bibliography covers the following: energy overviews, solar overviews, conservation, economics and law, thermal power, thermionic and thermoelectric, ocean, wind power, biomass and photochemical and large photovoltaics. (MHR)

42536 **Solar energy heat collector with selective coating and vacuum thermal insulation.** Umarov, G.Ya.; Trukhov, V.S.; Gaziev, U.Kh.; Baymatov, T.; Abidov, T.Z.; Klyuchevskii, Yu.E. *Geliotekhnika;* No. 4, 46-50(1978). (In Russian).

The paper describes two modifications of an efficient and operationally reliable solar energy thermal receiver with selective coating and vacuum-shield insulation. In the first modification, a double-walled tubular glass insulating jacket with evacuated cavity selectively coated on the inner wall fits over a metal pipe carrying a heat-transfer agent. The annulus between the glass and metal tubes is filled with a heat-conducting paste. In the second modification, the glass jacket is closed at one end and a heat tube is used for extraction of thermal energy. The glass heat receiver provides a reliable vacuum up to 400°C; beyond that temperature the vacuum is impaired by inleakage of atmospheric helium. A theoretical analysis is made of the heat balance of the proposed facilities as a basis for determining efficiency as a function of working conditions. It is found that the vacuum insulation and selective coatings have different effects on the thermal characteristics of the heat collector at different temperatures. The ratio of heat losses with a selective coating to heat losses with vacuum insulation and a nonselective black coating is equal to unity at a collector temperature of 130°C, falls below unity for lower temperatures, and is greater than unity for higher temperatures. Since vacuum insulation is more effective at low temperatures, while the selective coating has the greatest influence at high temperatures, the combination of the two considerably reduces heat losses.

42537 **NESEA '77: better thermal utilization.** Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977). 557p. (CONF-7709158—).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Separate entries were prepared for papers in the following categories: passive systems and greenhouses; methods of designing and cost estimating of solar systems; energy conservation retrofit options; heat pumps; design descriptions; domestic hot water; solar installation, maintenance experience, and performance; financial opportunities; marketing opportunities; waste to energy; contracting opportunities; operational improvements; manufacturing issues, cogeneration; research and development issues; utility interface; solar advantage design; wind energy conversion; legal and legislative issues; government programs; and the New England Electric Solar Hot Water Heating Experiment. The opening remarks by John T. Schnebly were not abstracted. (MHR)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 42669

42538 (LA-UR—79-1335) **Small-scale solar simulator for indoor testing of collector modules and materials.** Grimmer, D.P.; Bronisz, L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790541—6). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A small-scale solar simulator has been constructed for the indoor testing of collector modules and materials at LASL. The simulator design follows general construction guidelines suggested in the work of Yass and Curtis of NASA-Lewis, but modifications were necessary to insure a +- 10% uniform flux over a 0.1m^2 area. Considerable adjustments were necessary to achieve desired performance for the testing of collector modules and materials. These adjustments and details of simulator construction, including design schematics and simulator mounting, are described below. Also presented are flux maps for the twelve-lamp array. Finally, construction materials costs are discussed for this inexpensive solar simulator suitable for many-testing applications.

42539 (N—79-11613) **Radiation regime of inclined surfaces.** Kondratyev, K.Y. (World Meteorological Organization, Geneva (Switzerland)). 1977. 95p. NTIS PC A05/MF A01.

The importance of understanding the radiation regime of inclined surfaces in any attempt to make direct use of solar radiation as a source of energy is stressed. The approach suggested is to make use of available data on incoming direct, scattered and global radiation from stations which relate to horizontal surfaces and from this deduce the corresponding radiation component fluxes on inclined surfaces.

42540 (PB—289269) **Workbook for approximate calibration of solar radiation sensors. Technical memo.** Machta, L. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Aug 1978. 50p. NTIS PC A03/MF A01.

The workbook outlines a method of calculating solar radiation from such determinable parameters as zenith angle of the sun, ground reflectivity, turbidity, and precipitable water. And, since correction factors for turbidity and precipitable water vapor are potential sources of error, the workbook also provides methods for determining or estimating the amount of error. Values of solar radiation so calculated for a given station can be compared with actual values obtained by instruments at that station, and the instruments can thus be calibrated . The method is accurate to within 5% to 10% of the world standard for prescribed conditions. Since the procedure calculates direct and global radiation under clear skies, the predicted values may also be used for applications other than calibration, such as evaluation of data from instruments of undetermined accuracy, provided that the procedure's limitations are appreciated.

42541 (SAND—79-0418) **Graphical representation of TMY solar radiation availability for one- and two-axis solar collectors.** Lukens, L.L.; Peters, R.R. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 113p. Dep. NTIS, PC A06/MF A01.

The evaluation of candidate solar energy systems is affected by the insolation data used in the analysis. Information is presented about the availability of direct normal radiation to three tracking modes of concentrating collectors (two-axis, east-west, and north-south horizontal axis tracking collectors) for the 26 TMY stations. The data presented include energy availability, efficiency based on the direct normal radiation availability, and energy distribution.

42542 (SAND—79-1120C) **Solar radiation model validation.** Hall, I.J.; Prairie, R.R.; Anderson, H.E.; Boes, E.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790541—1). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

A study of the accuracy of three solar radiation models is described. The data base used to assess the accuracy of these models was obtained from several sites in the new U.S. National Weather Service Network. Each of the models was used to estimate the solar radiation and the modeled radiation values were compared with observed radiation values. The most important results of these comparisons for the clear solar noon model and the total horizontal regression model are included here. (MHR)

42543 (UCRL—82080) **Predicting solar energy fluxes in polluted urban areas.** Galloway, T.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 9p. (CONF-790803—18). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

A method is presented which utilizes known molecular absorption coefficients for gaseous air pollutants and various manmade and natural aerosols in an urban atmospheric model to predict the atmospheric optical thickness and thus the ratio of ground level direct incident flux to insolation flux above the atmosphere. A prediction method was also established for the representative values of the unpolluted air background that has been commonly used in the past by the solar energy designer, so that one can derive an urban solar energy correction factor. The prediction method has been tested by comparison with available worldwide observatory measurements in both northern and southern hemispheres. Detailed daily local measurements were also made over a two year period in the San Francisco Bay Area in order to verify the overall accuracy and sensitivity to the various air pollutant input parameters of ozone, nitrogen oxides, natural dust and smog aerosols. The method reduces the incident solar flux design error from the typical 30% to less than 5% for urban areas.

42544 **Meteorological data use in solar energy system design in New England.** Atwater, M.A.; Ball, J.T. (Center for the Environment and Man, Inc., Hartford, CT). pp 105-108 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

It is concluded that economical design of solar systems has been hampered by lack of accurate radiation data in New England. In the future, NOAA will be making radiation measurements at Caribou, Burlington, and Boston. Lacking observations, the next best approach is numerical computations based on standard meteorological data. The CEM model provides that data. The model and its applications are described. (MHR)

ECONOMICS

REFER ALSO TO CITATION(S) 42673

42545 (HCP/M2522—01) **Application and system design study for cost-effective solar photovoltaic systems at federal installations.** (Planning Research Corp., McLean, VA (USA)). Mar 1979. Contract EG-77-C-01-2522. 133p. Dep. NTIS, PC A07/MF A01.

The results are given of an effort to identify the potential for cost-effective solar photovoltaic power systems applications within the U.S. Federal Government. An implementation plan is provided for the installation of the first phase of cost-effective applications. (MHR)

42546 **Through the window.** Anderson, B. pp 387-389 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The economics of nuclear energy, solar energy, and energy conservation are compared briefly. (MHR)

42547 **Progress in the solar industry: an overview.** Friedlander, A.F. pp 25-28 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The problems of marketing that exist for manufacturers and some of the reasons for them are discussed. Some of these problems are distribution, training, costs, and production capacity. (MHR)

42548 **Paine Webber's role in solar energy.** Popkin, I.D. (Paine, Webber, Jackson, and Curtis, New York, NY). pp 253-258 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Paine Webber's role in the development of solar energy is described. This includes public education and financial guidance. A Paine Webber information bulletin on solar energy is included. (MHR)

42549 **HUD solar status: solar and oil heat to mix profitably.** Burkhardt, C.H. (New England Fuel Institute, Boston, MA). pp 265-267 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Why and how the independent oil dealers of the six New England states are preparing to capture a substantial portion of the region's solar energy market is explained in a question and answer format. (MHR)

42550 **Public acceptance of solar energy.** Perry, F. pp 269-273 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Ways of combatting adverse publicity and public apathy are discussed. The establishment of standards, warranties, marketing, and installing are covered. (MHR)

42551 **Commercial development of solar energy.** Sharrard, G.F. pp 275-278 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Policies for successful commercial development of solar equipment are discussed. Careful attention to cost-effectiveness, durability, and business enterprise is emphasized. (MHR)

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 42548, 42549, 42550, 42560, 42575, 42643, 42665, 42673, 43246

42552 (LA-UR—79-1369) **Status review of the technology assessment of solar energy program.** Altseimer, J.H.; Blaunstein, R.P. (Los Alamos Scientific Lab., NM (USA); Department of Energy, Washington, DC (USA). Office of Environment). 1979. Contract W-7405-ENG-36. 6p. (CONF-790541—4). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

An interim status report is given on the Technology Assessment of Solar Energy (TASE) Program sponsored by the Office of

Environment of the Department of Energy (DOE). A number of emerging solar technologies and selected applications are being assessed for the environmental, institutional, and social impacts resulting from the large-scale deployment of decentralized solar technologies. Two national energy scenarios for the year 2000 are being used, one predicting 6 quads of solar and the other 14.2 quads. A few results of a preliminary study of the system characterization data are given.

42553 (PB—287772) **Environmental and safety considerations for solar heating and cooling applications.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Sep 1978. Contract DOE-EA-77-A-01-6010. 34p. NTIS PC A03/MF A01.

The HUD Minimum Property Standards (MPS) and the residential and commercial interim performance criteria (IPC) prepared by the National Bureau of Standards address many health and safety considerations that need to be considered by solar heating and cooling system designers. For example, factors such as the toxicity and flammability of heat transfer fluids are often not considered in the design of systems. Similarly, attention is seldom paid to the safe disposal of these fluids. These problems are compounded by the lack of clear guidelines as to which fluids constitute hazards that warrant special consideration. This report is intended to create an increased sense of awareness of the health and safety aspects of solar heating and cooling applications by extracting and amalgamating pertinent provisions of the MPS and IPC documents. Some of the areas that are addressed include: structural safety, heat transfer fluid toxicity and flammability considerations including the protection of potable water, effects of solar equipment on the fire resistance of buildings, and protection from physical hazards.

42554 **Solar law: present and future, with proposed forms.** Kraemer, S.F. New York, NY; McGraw Hill Book Co. (1978). 373p. Shepard's, Inc., P.O. Box 1235, Colorado Springs, CO 80901.

This book is intended to provide a legal and practical analysis of those concerns and other issues that will evolve with increased use of solar power. A review of the law concerning easements, covenants, zoning, land use regulations, public nuisance, private nuisance, eminent domain, the appropriation doctrine, transferable development rights, air pollution, and building codes accompanies conclusions and recommendations for application of these bodies of law for the further development of energy from the sun. Private and public interest and alternatives are considered in depth. Goals are identified. (MHR)

42555 **Energy partnership, or solar and the gas utility.** Robinson, G.W. (Bay State Gas Co., Canton, MA). pp 297-301 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The question of whether utilities in general should be in the solar business is discussed. Lists of the ways that utility involvement in solar would help the public and ways that such involvement might be of questionable value are presented. It is pointed out that the lasting benefit of solar is not that it is a cheaper form of energy, but rather that it is an additional fuel source. (MHR)

42556 **Government initiatives to foster solar energy development.** Cross, J.M. (Senate Small Business Committee, Washington, DC). pp 475 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42557 **Solar technology transfer programs: present activities and future goals.** Graves, W. (Brookhaven National Lab., Upton, NY). pp 481 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42558 **Thermal effect of large-scale solar energy collection systems within urban regions.** Edelstein, R.B. (Hartford Graduate Center, CT); Atwater, M.A. pp 247-248 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The impact of the large-scale usage of solar collector systems for power generation in urban areas on the land and atmosphere adjacent to the collectors is investigated. The goal of the present study is to delve in more depth into the potential micro-climatic effects of solar collection systems than has been done previously. In order to achieve this goal, three preconditions had to be met: the selection of an atmosphere-land numerical simulation model; the modeling of the urban, suburban, and rural sectors; and the incorporation of solar collector properties into the model.

42559 **Banking industry issues.** Kondos, J.R. (Energy Marketing Associates, Boston, MA). pp 259-262 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The banking industry's perceptions of and attitudes toward solar energy are explored. A random sample of banks in New England and New York state chosen from the bank headquarters in these states were surveyed. The survey questions were divided into four categories to determine awareness, acceptance, perception of obstacles, and the banking industry's potential contributions to solar utilization. (MHR)

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 42645, 42648, 42734, 42744, 43253

42560 (BNL—25935) **Avoiding future health problems related to solar energy (photovoltaic) technology.** Stang, L.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 25p. (CONF-790447—1). Dep. NTIS, PC A02/MF A01.

From Health implications of the new energy technologies; Park City, UT, USA (4 Apr 1979).

The hazards involved in disposing of solar cells at the end of their service life are discussed. Several chemical elements that are likely candidates for photovoltaic development are enumerated, the present state of knowledge concerning their toxicities are commented on briefly; and studies that should be undertaken in the near future to provide adequate information on these toxicities are suggested. (MHR)

42561 (CONF-790451—1) **Assessment of low-cost manufacturing process sequences.** Chamberlain, R.G. (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EX-76-A-29-1012. 11p. Dep. NTIS, PC A02/MF A01.

From 3. European congress on operations research; Amsterdam, Netherlands (9 Apr 1979).

The Low-Cost Solar Array Project, sponsored by the U.S. Department of Energy, is managing an extensive research and development activity to reduce the cost of manufacturing photovoltaic solar arrays by a factor of approximately one hundred. This management objective implies the need for a capability to relate proposed and actual manufacturing process descriptions to manufacturing costs. The Solar Array Manufacturing Industry Costing Standards (SAMICS) methodology was developed to meet this need. An overview of this methodology is presented. Since the solar array manufacturing industry is expected to increase in capacity by several orders of magnitude when the price is reduced to a competitive level, it would be inappropriate to assume that indirect costs will be the same multiple of direct costs as is presently observed in the industry. Furthermore, identification of some other industry as similar would be highly questionable. Consequently, SAMICS contains a factory construction and staffing algorithm, which infers indirect requirements from the specified direct requirements and implicitly builds a hypothetical, dedicated factory for performing the specified manufacturing processes. SAMICS has been implemented by a computer program (SAMIS III). It has been applied to the assessment of Low-Cost Solar Array Project progress, and it has been used as a tool in the selection of research and development priorities.

42562 (CONF-790457—1) **Recent developments in the economic modeling of photovoltaic module manufacturing.** Chamberlain, R.G. (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EX-76-A-29-1012. 8p. Dep. NTIS, PC A02/MF A01.

From 1979 photovaltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

The Solar Array Manufacturing Industry Costing Standards (SAMICS) were developed to provide a standardized procedure for determining a reasonable market price for photovoltaic modules when manufactured by processes under development. Due to the generality of the approach used, application is now spreading to all other elements of the U.S. Photovoltaic Program and beyond. The SAMICS price is determined by constructing a hypothetical industry consisting of a sequence of companies which use the manufacturing processes of interest and are sized to produce the specified quantity. Operation of each hypothetical company, in a business environment, is then simulated. The direct requirements of all manu-

facturing processes are used to infer the indirect requirements associated with running the company. A financial model is used to estimate costs of doing business. The product price that produces just enough revenue to cover all costs and still provide a specified return on investment is determined. The methodology is available both as a manual procedure and as a computer program. The recently added capability to handle arbitrary operating schedules is explained; the revised procedure for calculation of one-time costs is discussed; and the results of a recent extensive validation study are summarized. (WHK)

42563 (COO—4094-31) **Flywheel energy storage and conversion system for solar photovoltaic applications.** Millner, A.R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1979. Contract EY-76-C-02-4094. 9p. (CONF-790305—6). Dep. NTIS, PC A02/MF A01.

From ASME gas turbine closed-cycle session; San Diego, CA, USA (11 Mar 1979).

A low-drag, low-power magnetic bearing and a permanent magnet brushless DC motor-generator have been developed for a satellite flywheel. These will be combined with a terrestrial flywheel and control electronics to make up a flywheel energy storage and conversion system for use in a stand-alone solar photovoltaic residence. Technical and economic performance analyses indicate that, contary to general thought, a flywheel system will be competitive if not superior to more conventional systems utilizing either present-day or advanced batteries. This derives from the ability of the flywheel to perform the functions of DC-to-AC inversion and optimal impedance matching between the PV arrays and the load in addition to providing energy storage. The motor-generator design will also be discussed. This paper describes the structural topology, performance data, design parameters, and test measurements of the magnetic bearing and motor-generator as well as a description of the flywheel and control electronics to be used. A preliminary discussion of the economic aspects is also included.

42564 (DOE/JPL/954331—5) **Silicon materials task of the low cost solar array project(Phase III): effect of impurities and processing on silicon solar cells. Thirteenth quarterly report, October—December 1978.** Hopkins, R.H.; Davis, J.R.; Blais, P.D.; Rohatgi, A.; Campbell, R.B.; Rai-Choudhury, P.; Mollenkopf, H.C.; McCormick, J.R. (Dow Corning Corp., Midland, MI (USA)). Jan 1979. Contract NAS-7-100-954331. 50p. Dep. NTIS, PC A03/MF A01.

The objective of the program is to define the effects of impurities, various thermochemical processes and any impurity—process interactions on the performance of terrestrial silicon solar cells. Gettering experiments with phosphorus oxychloride gas phase treatments at 950°C, 1000°C, and 1150°C have been completed for two Ti-doped ingots (3×10^{13} cm^{-3} and 2.1×10^{14} cm^{-3} Ti doping levels, respectively), two molybdenum doped ingots (8×10^{11} and 4.2×10^{12} cm^{-3} Mo) and one iron-doped ingot (3×10^{14} cm^{-3} Fe). First generation Co and W-doped ingots were grown and processed to solar cells. Miniature solar cells and diodes were used to map the characteristics of wafers from a 3 inch diameter ingot doped with Mn or Ti. A model has been developed to describe the behavior of solar cells bearing non-uniform distributions of impurities or defects.

42565 (DOE/JPL/954339—11) **Evaluation of selected chemical processes for production of low-cost silocon. (Phases I and II.) Final report, October 9, 1975—July 9, 1978. Silicon Material Task, Low-Cost Solar Array Project.** Blocher, J.M. Jr.; Browning, M.F. (Battelle Columbus Labs., OH (USA)). 9 Jul 1978. Contract NAS-7-100-954339. 124p. Dep. NTIS, PC A06/MF A01.

The zinc reduction of silicon tetrachloride in a fluidized bed of seed particles to yield a granular product was studied along with several modifications of the thermal decomposition or hydrogen reduction of silicon tetraiodide. Although all contenders were believed to be capable of meeting the quality requirements of the LSA Project, it was concluded that only the zinc reduction of the chloride could be made economically feasible at a cost below $10/kg silicon (1975 dollars). Accordingly, subsequent effort was limited to evaluating that process. A miniplant, consisting of a 5-cm-diameter fluidized-bed reactor and associated equipment was used to study the deposition parameters, temperature, reactant composition, seed particle size, bed depth, reactant throughput, and methods of reactant introduction. It was confirmed that the permissible range of fluidized-bed temperature was limited at the lower end by zinc condensation (918 C) and at higher temperatures by rapidly decreasing conversion efficiency [by 0.1 percent per degree C from 72 percent (thermodynamic) at 927 for a stoichiometric mixture]. Use of a graded bed temperature was shown to increase the conversion efficiency over that obtained in an isothermal bed. Other aspects of the process such as the condensation and fused-salt electrolysis of the $ZnCl_2$ by-product for recycle of zinc and chlorine were studied to provide information required for design of a 50 MT/year experimental facility, visualized as the next stage in the development. Projected silicon costs of $7.35 and $8.71 per kg (1975 dollars) for a 1000 MT/year facilitywere obtained, depending upon the number and size of the fluidized-bed reactors and $ZnCl_2$ electrolytic cells used. An energy payback time of 5.9 months was calculated for the product silicon.

42566 (DOE/JPL/954339—11-12) **Evaluation of selected chemical processes for production of low-cost silicon (Phase III). Silicon material task, low-cost solar array project. Eleventh-twelfth quarterly progress report, April 1—September 30, 1978.** Blocher, J.M. Jr.; Browning, M.F. (Battelle Columbus Labs., OH (USA)). 31 Oct 1978. Contract NAS-7-100-954339. 44p. Dep. NTIS, PC A03/MF A01.

Development of a process for producing high-purity silicon by zinc reduction of silicon tetrachloride in a fluidized bed of seed particles to yield a free-flowing granular product is reviewed. Progress in finalizing the design of a 50 MT/year experimental process facility is reported. (MHR)

42567 (DOE/JPL/954356—7) **Silicon on ceramic process. Silicon sheet growth and device development for the large-area silicon sheet and cell development tasks of the Low-Cost Solar Array Project. Annual report No. 3, September 20, 1977—September 29, 1978.** Chapman, P.W.; Zook, J.D.; Heaps, J.D.; Maciolek, R.B.; Koepke, B.; Grung, B.L.; Butter, C.D.; Schuldt, S.B. (Honeywell Corporate Material Sciences Center, Bloomington, MN (USA)). 31 Oct 1978. Contract NAS-7-100-954356. 108p. Dep. NTIS, PC A06/MF A01.

The objective of this research program is to investigate the technical and economic feasibility of producing solar-cell-quality sheet silicon by coating one surface of carbonized ceramic substrates with a thin layer of large-grain polycrystalline silicon from the melt. During the past year, the cell development task of the low-cost solar array project has also sponsored work leading to the solution of solar-cell-oriented problems unique to silicon-on-ceramic material. This work is described also. Fracture toughness and thermal shock measurements were made on various mullite compositions. The dip-coater experimentation involved using a variety of crucible positions and gas flow rates to improve coating speeds. The construction of the continuous coating facility was completed. Many modifications to the original design have been made to obtain better control of the temperature profile of the coater. An experimental dip-coater has been completed. The goal of this effort is to increase coating speeds to from 0.15 to 0.3 cm/sec without sacrificing material quality. The best slotted SOC cell fabricated to date has a 7.5 percent conversion efficiency (antireflective-coated, AM1, total area 4.1 cm^2). A standardized cell fabrication process was developed for slotted and unslotted SOC solar cells. Modeling activities have concentrated on three major areas: silicon growth, device design, and economic analysis. An economic projection was made using standard SAMICS procedures which indicated the target cost of $18/m^2 for silicon sheet could be met for certain SOC manufacturing conditions.

42568 (DOE/JPL/954376—7) **Laser-zone growth in a ribbon-to-ribbon (RTR) process silicon sheet growth development for the large area silicon sheet task of the low-cost solar array project. Annual report, October 1, 1977—September 30, 1978.** Baghdadi, A.; Gurtler, R.W.; Legge, R.; Sopori, B.; Ellis, R.J. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1978. Contract NAS-7-100-954376. 83p. Dep. NTIS, PC A05/MF A01.

A new calculation is included of the effects of thermal stresses during growth on silicon ribbon quality. Thermal stress distributions are computed for ribbon growth under a variety of temperature profiles. It is shown that the width dependence is not as large as had previously been assumed. Under practical growth conditions, the stresses are actually often below the yield point. It is also shown that, for the thermal profiles presently in use, buckling is probable for widths greater than 4 - 6 cm. Two ideal temperature profiles are described which could result in ribbons grown without either high dislocation generation or buckling. A growth rate of 55 cm^2/min with a single ribbon was achieved. The growth of RTR ribbon with a fairly uniform parallel dendritic structure was also demonstrated. Encouraging results were obtained with two approaches for reducing the Mo impurity level in polycrystalline feedstock. Neutron Activation Analysis has shown that the Mo level can be reduced to below the level of detection by etching the polycrystalline ribbon surface. Coating the Mo substrate with Si_3N_4 does not affect thermal shear separation of the polyribbon (Si_3N_4 is a well-known diffusion barrier); this process shows promise of improving cell efficiencies and also increasing the useful life of the molybdenum substrate. A number of solar cells have been fabricated on RTR silicon grown-from CVD feedstock.

42569 (DOE/JPL/954817—3) **Epitaxial silicon growth for solar cells. Quarterly report No. 3, April 1—June 30, 1978.** D'Aiello, R.V.; Robinson, P.H.; Richman, D. (RCA Labs., Princeton, NJ (USA)). Jul 1978. Contract NAS-7-100-954817. 28p. Dep. NTIS, PC A03/MF A01.

The epitaxial growth of thin solar-cell structures was extended to include another potentially low-cost form of silicon: upgraded metallurgical grade silicon obtained from Dow Corning. An AM-1 efficiency of 12.4% was achieved with a cell structure

having only 14 μm of silicon grown on the Dow Corning. The best efficiency obtained was 13% on a 50-μm thick structure. It was found that titanium (2×10^{14} A/cm^{-3} level) intentionally incorporated into the substrates primarily causes a reduction in the short-circuit current for both epitaxial and bulk cells. However, the epitaxial cells were much less effected by the presence of titanium and efficiencies as high as 11.7% were obtained while the efficiency for bulk cells was ~ 8%. Preliminary experiments in a laboratory model of RCA's advanced rotary disc reactor have produced solar cells with 10 to 12% efficiency. These cells were grown on single-crystal control substrates and the growth which included studies of submicron surface layers showed a trend toward increased short-circuit current density for shallower junctions.

42570 (DOE/JPL/954852—1) **Structure and electrical activity of planar defects in EFG ribbons. First quarterly report, January 1—March 31, 1979.** Ast, D.G. (Cornell Univ., Ithaca, NY (USA)). 15 Apr 1979. Contract NAS-7-100-954852. 11p. Dep. NTIS, PC A02/MF A01.

The structure and electrical activity of planar defects in EFG Silicon was investigated by optical, electron beam induced current (EBIC), and transmission electron microscopy (TEM). What appears to be twin boundaries by both optical microscopy + etching, and by EBIC are in reality systems of microtwins, some of which are only a few atomic lattice planes thick. The electrical activity of planar defects appears to be correlated with emission of dislocations especially at termination points. Impurity effects may also play a role. Twin boundaries per se appear not to be electricaly active.

42571 (DOE/JPL/954877—4) **Study program to develop and evaluate die and container materials for the growth of silicon ribbons. Quarterly report No. 4.** Grayson, P.E.; Addington, L.A. (Eagle-Picher Industries, Inc., Miami, OK (USA). Miami Research Labs.). Oct 1978. Contract NAS-7-100-954877. 88p. Dep. NTIS, PC A05/MF A01.

Initial sessile drop experiments on SiC, Si_3N_4 and AlN have been conducted. Very promising results have been achieved on both SiC and Si_3N_4 where minimal penetration of these CNTD coatings by molten silicon was observed. More detailed characterization of the CNTD microstructures was accomplished as well as x-ray characterization of the third and fourth candidate materials system sets (ie. AlN and altered Si_3N_4). Polished sections of post sessile drop specimens were also prepared and evaluated. The results of the latter continue to be encouraging. The techniques of full scale crucible hot pressing were developed and die grinding development was initiated. The apparatus for measurement of oxygen partial pressure was reconstructed and calibrated with a known reference gas to overcome flow rate effects. The sessile drop temperature measurement procedure was calibrated for absorption by the pyrex view-port and additional Auger electron analysis was performed at the interface of molten silicon with CNTD Si_3N_4 and AlN. Production of altered Si_3N_4 coatings on hot pressed discs for sessile drop experiments was completed.

42572 (DOE/JPL/954995—2) **Develop silicone encapsulation systems for terrestrial silicon solar arrays. Second quarterly progress report, July 3—September 29, 1978.** (Dow Corning Corp., Midland, MI (USA)). 10 Oct 1978. Contract NAS-7-100-954995. 39p. Dep. NTIS, PC A03/MF A01.

The Sunshine Carbon Arc Weather-Ometer stressing of silicone materials with known weathering characteristics was continued. The samples were checked periodically for changes in the properties which had been measured and reported on the original outdoor exposure samples. One cell circuits were coated with silicone based materials which passed the accelerated soiling test. The output of these cells was monitored as a function of outdoor exposure time to determine the effect of dirt accumulation on cell performance. Several UV screening agents were incorporated into silicone materials which passed the accelerated soiling test. The light transmittance vs wavelength for several UV absorbers at different concentrations was plotted. Lo-Iron/sup TM/ sheet glass and Super Dorlux have been identified as potential candidates for use as superstrate and substrate respectively. These structural supports are being used with thin silicone based coatings over 2-cell circuits in JPL humidity and thermal cycling tests.

42573 (DOE/TIC—10112) **GaAs thin-film solar cells. Quarterly technical status report, 1 October—31 December 1977.** (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Dec 1977. Contract EX-76-A-01-2295-028. 12p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to demonstrate the feasibility of fabricating efficient, inexpensive thin-film GaAs solar cells for large-scale terrestrial applications. The program is initially addressing the two principal problems involved in the fabrication of such cells: preparation of large-grained GaAs films on low-cost substrates and formation of barriers for charge separation. Two alternative approaches are being investigated in each area. These are: laser crystallization and chemical vapor deposition of GaAs films and formation of charge separation barriers by preparation of shallow homojunctions by chemical vapor deposition and preparation of heterojunctions with transparent conductors.

42574 (DOE/TIC—10113) **GaAs thin-film solar cells. Quarterly technical status report, 1 January—31 March 1978.** (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Mar 1978. Contract EX-76-A-01-2295-028. 10p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to demonstrate the feasibility of fabricating efficient, inexpensive thin-film GaAs solar cells for large-scale terrestrial applications. The program is initially addressing the two principal problems involved in the fabrication of such cells: preparation of large-grained GaAs films on low-cost substrates and formation of barriers for charge separation. Two alternative approaches are being investigated in each area.

42575 (LA-UR—79-950) **Selected results from the technology assessment of solar energy program.** Krupka, M.C.; Altseimer, J.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790611—3). Dep. NTIS, PC A02/MF A01.

From AIAA terrestrial energy systems conference; Orlando, FL, USA (4 Jun 1979).

An interim status report is given on the Technology Assessment of Solar Energy (TASE) Program sponsored by the Office of Environment of the Department of Energy (DOE). A number of emerging solar technologies and selected applications are being studied from environmental, institutional and social viewpoints. A broad objective is to assess the impacts resulting from the large-scale deployment of decentralized solar technologies. Initial emphasis has been placed upon a technical characterization of the technology and subsequently upon the development of a representative model system for a given application upon which an environmental analysis could be made. As an example, study results are given for a model photovoltaic system for residential use. The results to date emphasize the benign nature of the system operationally but suggest environmental concerns related to solar cell manufacture, energy storage systems and ultimate system disposal. The environmental impacts noted for the photovoltaic system described herein should be considered for other applications where large-scale usage or deployment is projected.

42576 (NSF/RANN/SE/AER—73-03197/PR/77/1) **Silicon Schottky photovoltaic diodes for solar energy conversion. Quarterly progress report, January 1—March 31, 1977.** Anderson, W.A. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Electrical Engineering). May 1977. 22p. (PB—268457). Dep. NTIS, PC A02/MF A01.

Fabrication variations have increased open-circuit voltage of the Schottky cell to 0.60 V. Schottky cells on IBM ribbon have achieved 7.3% efficiency and V/sub oc/ = 0.54 V. Ta_2O_5 as an AR coating serves to increase J/sub sc/ to 26 mA/cm^2 but causes decreased V/sub oc/. Solar cell stability still looks promising but a hermetic seal may be required.

42577 (PB—287417) **Silicon schottky photovoltaic diodes for solar energy conversion. Annual progress report 1 Jan-31 Dec 77.** Anderson, W.A. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Electrical Engineering; Energy Research and Development Administration, Washington, DC (USA). Div. of Solar Energy). Jan 1978. 46p. NTIS PC A03/MF A01.

This progress report covers work accomplished on a research study involving a five fold plan to achieve 12.5 percent efficiency and apply the Schottky process to more economical silicon substrates. A study of the interfacial insulating layer was made to correlate layer thickness and composition with solar cell performance. Scanning electron microscope and Auger spectrographic analyses were used with electronic tests to investigate this effect. The results obtained from these procedures should enable the adjustment of the fill factor by altering processing variables. Processing variables were studied using substrate heating, substrate blasing, and sputtered-top metal layers. The Schottky process was applied to ribbon silicon and polysilicon to investigate the efficiency as applied to continuous fabrication techniques. Experimental results will be compared to computer-generated data using the model of a solar cell with variable parameters, and environmental tests will continue on existing and new solar cells. Several accomplishments achieved to date include: the fabrication of a 12.2 percent Cr-MIS cell on single-crystal Si wafers, a 9.8 percent efficiency obtained using a Ti-MIS cell, and a 7.2 percent efficiency recorded using a Cr-MIS structure on Wacker polycrystalline Si.

42578 (PB—287629) **Cuprous oxide photovoltaic cells. Quarterly report no. 2, 1 Jan 76—31 Mar 76.** Trivich, D. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). Mar 1976. 9p. NTIS PC A02/MF A01.

Procedures which have resulted in considerable improvement in the output of the copper/cuprous oxide Schottky barrier photovoltaic cells are reported. Some of these procedures include the

annealing of the cuprous oxide, better conditions of etching and heat treatment, and use of grids. The copper/cuprous oxide cells have attained values of J(sc) = 9.6 mA/sq cm and V(oc) = 0.35 V and the cell resistance has been reduced to about 20 ohms. Photovoltaic junctions on cuprous oxide have also been prepared with aluminum, tin, and tin oxide with fair success with aluminum and poor but positive results with tin and tin oxide. Theoretical analysis indicates that junction characteristics depend to some extent on the metal used to make contact. Future plans include work on the Schottky barriers using other metals such as silver, indium, lead and cadmium, as well as work on heterojunctions with oxides of tin, indium, and other metals. Explorations are planned with the electrodeposited cuprous oxide.

42579 (SAN—1286-5) **Amorphous-silicon solar cells. Quarterly report No. 5, November 1, 1977—January 31, 1978.** Carlson, D.E. (RCA Labs., Princeton, NJ (USA)). Jan 1978. Contract EY-76-C-03-1286. 51p. (PRRL—78-CR-11). Dep. NTIS, PC A04/MF A01.

The hydrogen content of a-Si:H films can be varied from ~ 15 to ~ 50 at.% by varying deposition parameters such as substrate temperature, discharge power, and SiH_4 pressure. The photovoltaic properties show a dependence on the hydrogen content that can be mainly attributed to variations in the optical gap of the a-Si:H. Deuterium diffusion studies indicate that the motion occurs via the hopping of neutral atoms. Photoluminescence has been used to show that dehydrogenated a-Si:H can be rehydrogenated in a hydrogen discharge. Photoconductivity measurements indicate that the density of hole traps in lightly dopes, p-type a-Si:H is ~ 2.5 x 10^{16} cm^3 at illumination levels of ~ 0.01 suns. The optimum doping condition for the deposition of an n^+ layer on metal substrates corresponds to ~ 0.2% PH_3 in the SiH_4 discharge. New structures have been developed that can be fabricated entirely in a rf capacitive discharge system.

42580 (SAN—1286-8) **Amorphous-silicon solar cells. Final report, July 1, 1976—September 30, 1978.** Carlson, D.E.; Crandall, R.S.; Goldstein, B.; Hanak, J.J.; Moore, A.R.; Pankove, J.I.; Staebler, D.L. (RCA Labs., Princeton, NJ (USA)). Oct 1978. Contract EY-76-C-03-1286. 141p. Dep. NTIS, PC A07/MF A01.

The glow-discharge systems that have been used to deposit hydrogenated amorphous silicon (a-Si:H) and the various structures and processing steps that have been used to make solar cells are described. Material properties were studied such as hydrogen content, optical absorption, diffusion of hydrogen and impurities, stress, photoluminescence, resistivity, photoconductivity, light-induced conductivity changes, drift mobility, and density of gap states. Device characteristics such as I-V, C-V, and collection-efficiency measurements are presented. A laser-scanning system has been utilized to characterize a-Si:H solar cells. The results of stability tests that indicate good lifetime for properly fabricated a-Si:H solar cells are presented.

42581 (SAND—79-0504C) **Analytical evaluation of a solar thermophotovoltaic (TPV) converter.** Edenburn, M.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-790541—2). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

This parametric analysis of a thermophotovoltaic (TPV) converter considers emitter temperature, cell reflectance to radiation with energy below the cell's bandgap energy, and concentration ratio requirements. The concentration ratio is rigorously considered to determine its influence on converter performance. Important conclusions are that an emitter temperature of 2000°K is optimal; a cell reflectance value of 0.98 is required for below-bandgap irradiation; a secondary concentrator must be used with a parabolic-dish primary; and a mirror quality resulting in a 4-mrad reflected-beam dispersion is required for a 24% conversion efficiency.

42582 (SERI/TR—32-150) **Photovoltaics research. Annual report-FY78, October 1, 1977—September 30, 1978.** Kazmerski, L.L. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1979. Contract EG-77-C-01-4042. 171p. Dep. NTIS, PC A08/MF A01.

Research areas include: (1) solid-state and device theory; (2) very high efficiency cells (e.g., III-V, single crystal semiconductor devices); (3) intermediate efficiency thin-film cells (e.g., amorphous silicon devices); (4) silicon purification; (5) silicon crystallization; (6) device processing; (7) advanced II-VI technologies (e.g., spray and paste techniques); (8) surface and interface analysis, and (9) measurement development. Due to delays in staffing, on-site laboratory completion and capital equipment acquisition, research activities could not be initiated in all nine of these areas during FY78. While research planning and experiment design were undertaken for all nine of these areas, surface and interface analysis, silicon crystallization and characterization, and measurement development provided the primary results during FY78. Accomplishments described include: (1) growth of the first ternary semiconductor by molecular beam epitaxy (MBE) and the fabrication of the first MBE $CuInSe_2$/CdS heterodiode for photovoltaic investigations; (2) development of an accurate solar spectrum (SOLTRAN) for photovoltaic applications and dissemination to DOE Advanced R & D contractors; (3) modeling of polycrystalline heterojunction solar cells, emphasizing grain boundary and interface mechanism; (4) prediction of heterojunction and multijunction solar cell performance based upon SOLTRAN; (5) characterization of semiconductor thin films on conductive substrates; (6) AES/SIMS evaluation of impurity segregation in multicrystalline silicon; (7) AES/SIMS investigation of interdiffusion, especially grain boundary diffusion, in Cu-ternary thin-film solar cells; and (8) acoustic microscopy studies of multigrained silicon.

42583 (TID—28970) **Heterostructure single crystal silicon photovoltaic solar cells. Sixth quarter report, January 1—March 31, 1978.** Szedon, J.R.; Temofonte, T.A.; O'Keeffe, T.W.; Fonash, S.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 11 Oct 1978. Contract EY-76-C-03-1282. 26p. Dep. NTIS, PC A03/MF A01.

The use of scanned laser (6330A) spot excitation of MIS cells has allowed estimation of grain boundary geometry effects on V/sub OC/ and I/sub SC/ of cells prepared on polycrystalline silicon substrates. Cells on polycrystalline material prepared by Czochralski and dendritic web growth methods have been studied. Photocurrent suppression, by grating boundary recombination mechanisms, of about 3% was estimated for excitation at the laser wavelength for both materials. Details of total grain boundary length, width of the affected region and local strength of the suppression were different for the two cases. Bucking current density (assumed normal to the boundary walls cutting through the wafer) values were estimated to be 40 to 80% of those of the usual bucking current normal to the illuminated surface. Gold Schottky barrier and MIS cells on n-substrates exhibit barrier height and open circuit voltage sensitivity to details of the silicon etch preceding metallization or oxidation. TEM studies established that thin silver films on oxidized silicon surfaces show greater agglomeration (accounting for higher sheet resistance) than films of comparable thickness on bare silicon surfaces.

42584 (TID—28991) **Heterostructure single crystal silicon photovoltaic solar cells. Seventh quarterly report, April 1—June 30, 1978.** Szedon, J.R.; Temofonte, T.A.; Dickey, H.C.; Hoffmann, R.A.; Blankenship, B.A.; O'Keeffe, T.W.; Fonash, S.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1 Nov 1978. Contract EY-76-C-03-1282. 40p. Dep. NTIS, PC A03/MF A01.

A number of approaches have been explored to improve the short circuit-fill factor product of Al-SiO_2-pSi cells from the point of view of the trade-off between optical transmission into the silicon and series resistance contribution from the high sheet resistance components of the cell. The approaches have involved material modification (evaporating aluminium in an oxygen containing ambient to improve transmission), partitioning the cell surface between alternate strips of metal (thin or thick) and bare silicon having an inversion layer and illuminating a carefully designed cell on the surface opposite that bearing the MIS collecting barrier. Experimental cells with comparable efficiency have been made with all four approaches. Details of cell operation and models for performance have been examined carefully. The inversion layer cell (with narrow opaque metal strips providing an MIS contact to an inversion layer over the full illuminated cell surface) is the most promising of the conventional approaches. The back illuminated cell with a BSF region is very attractive from standpoints of environmental stability, performance optimization and applicability of thin polycrystalline silicon films. Work at Penn State has established that the Al-SiO_2-pSi cell is bulk diffusion controlled in dark current behavior and stores charge within the thin SiO_2 layer.

42585 **High-temperature lifetesting of Al/SiO/sub x//p-Si contacts for MIS solar cells.** Godfrey, R.B.; Green, M.A. (School of Electrical Engineering, University of New South Wales, Kensington, Australia 2033). *Appl. Phys. Lett.;* **34**: No. 12, 860-861(15 Jun 1979).

High-temperature lifetesting of Al/SiO/sub x/ (10—15 A)/p-Si contacts for high-efficiency MIS solar cells is reported. Electrical degradation in the temperature range 270—400 °C was governed by an activation energy of 2.56 +- 0.12 eV, indicating that the reduction of the thin oxide layer by Al was the mechanism responsible. Extrapolating to lower temperatures indicates that this process proceeds at a negligible rate below 200 °C.

42586 **Theoretical efficiency of SnO_2/Si solar cells.** Ghosh, A.K.; Fishman, C.; Feng, T. (Exxon Research and Engineering Company, Linden, New Jersey 07036). *J. Appl. Phys.;* **50**: No. 5, 3454-3458(May 1979).

At present SnO_2/Si solar cells with efficiencies greater than 12% have been fabricated. The maximum theoretical efficiency attainable with such cells is of great interest and is reported in the present paper. The cells behave very much like MIS devices. The

insulating oxide and surface density of states at the interface affect the performance of the device mainly through the diode constant and the barrier height phi/sub B/. The theoretical maximum short-circuit photocurrent, the open-circuit photovoltage, and the fill factor are 36 mA/cm², 0.66 V, and 0.84, respectively. They yield a maximum theoretical efficiency of 20%.

42587 IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978). 1346p. (CONF-780619—).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

This conference record contains 250 papers of which 3 appear in abstract form only. 240 papers are indexed separately. Topics dealt with include: the direction of photovoltaics, tests and demonstrations of photovoltaic power systems, measurement of material properties, radiation and space environmental effects in solar cells, materials and process development for low cost production, solar cells from "newer" materials, space solar array technology, low cost research and development for large scale production, solar cells from alternative materials, silicon material and sheet growth, Cu$sub x$S/CdS cells, silicon cells for space applications, polycrystalline silicon material and impurity effects, indium-tin oxide cells, space radiation effects and GaAs cells, low-cost production device and module technology, silicon MIS cells, solar energy concentrators, field tests, and terrestrial applications of photovoltaic power systems.

42588 Trends in photovoltaic development outside the united states. Palz, W. (Comm of the Eur Communities, Brussels, Belg). pp 9-15 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Photovoltaic activities are reviewed for Belgium, France, Germany (Federal Republic), Italy, the Netherlands, the United Kingdom, India, Iran, Japan and Mexico. The Photovoltaic Program directed by the Commission of the European Communities is included in this outline.

42589 Forward-bias capacitance and current measurements for determining lifetimes and band narrowing in p-n junction solar cells. Neugroschel, A.; Chen, P.J.; Pao, S.C.; Lindholm, F.A. (Univ of Fla, Gainesville). pp 70-75 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A new method is described and illustrated for determining the minority-carrier diffusion length and lifetime in the base region of p-n junction solar cells. The method requires only capacitance measurements at the device terminals and its accuracy is estimated to be /plus or minus/5%. It is applied to a set of silicon p-n junction devices and the values of the diffusion lengths agree with those obtained using the current response to X-ray excitation but disagree with those obtained by the open-circuit-voltage-decay (OCVD) method. The reasons for the relative inaccuracy of OCVD applied to silicon devices are discussed. The capacitance method includes corrections for a two-dimensional fringing effects which occur in small area devices. For a device having highly-doped base region and surface (emitter) layer, the method can be extended to enable the determination of material properties of the degenerately doped surface layer. These material properties include the phenomenological emitter lifetime and a measure of the energy band-gap narrowing in the emitter. An alternate method for determining the energy band-gap narrowing from temperature dependence of emitter current is discussed and demonstrated.

42590 Measurement of free carrier lifetime in an illuminated solar cell from capacitance measurements. Harmon, S.Y.; Backus, C.E. (Ariz State Univ, Tempe). pp 76-82 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The small signal resistive and capacitive components of the ac impedance of an illuminated silicon solar cell were measured using a lock-in amplifier as a phase sensitive voltmeter. Based on the assumption of a dominant diffusion capacitative component of total device capacitance, the cell impedance data were used to compute the cell's device carrier lifetime as a function of incident energy. These results showed the device carrier lifetime decreased steadily with increasing incident energy. However, this interpretation ignores the effects of series resistance and transition region impedance of the data.

42591 Contactless measurement of lifetime by free carrier infrared absorption. Schwartz, R.J.; Gray, J.L. (Purdue Univ, West Lafayette, Indiana). pp 83-88 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A technique is described which allows the measurement of high injection free carrier lifetime without the necessity of making electrical contact to the wafer. The technique utilizes the free carrier absorption of an infrared beam to monitor the carrier concentration as a function of time after application of an exciting light pulse. The theory of the experiment is presented along with a description of the apparatus. A typical experimental result is compared with a theoretical prediction. The technique is found to be particularly useful in the monitoring of high injection lifetime in interdigitated back contact solar cells.

42592 Diffusion length inhomogeneities in silicon solar cells. Chu, T.L.; Stokes, E.D. (South Methodist Univ, Dallas, Tex). pp 95-99 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Minority carrier diffusion length in the base region of a solar cell is the most important factor affecting its long wavelength performance. Although the diffusion length in solar cells has been measured by several techniques, very little attention has been directed to diffusion length inhomogeneities. In this work, a high resolution technique utilizing short-circuit current collection has been used to measure the diffusion length profile in single crystalline silicon solar cells with or without light-bias. The short-circuit current profile generated by illuminating localized areas of solar cells with radiation of known energy and power density was also measured. A majority of the solar cells examined so far exhibit inhomogeneities in diffusion length and similar variations in short-circuit current density under long wavelength or white illumination.

42593 Directional solidification of crack-free silicon ingots by heat exchanger method. Khattak, C.P.; Schmid, F. (Cryst Syst, Inc, Salem, Mass). pp 137-141 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Silicon crystals are being grown for photovoltaic applications by a directional solidification casting technique. One of the major problems in casting silicon in silica crucibles is the cracking of the ingot during the cooling cycle. Graded crucibles have been developed which delaminate thereby eliminating cracking of the cast silicon. Boules as large as 3½ km have been solidified with a high degree of crystallinity. The origin of silicon carbide formed at high temperatures in vacuum has been attributed to the use of silica crucibles in contact with graphite retainers. Solar cells fabricated out of the cast silicon have shown conversion efficiencies of up to 14% (AM1).

42594 Development of a shingle-type solar cell module. Shepard, N.F. Jr.; Sanchez, L.E. (GE, Space Div, Philadelphia, Pa). pp 160-164 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The development of a solar cell module, which is suitable for use in place of shingles on the sloping roofs of residential or commercial buildings, is reported. This design consists of nineteen series-connected 53 mm diameter solar cells arranged in a closely packed hexagon configuration. These cells are individually bonded to the embossed surface of a 3 mm thick thermally tempered hexagon-shaped piece of ASG SUNADEX glass. Monsanto SAFLEX polyvinyl butyral is used as the laminating adhesive. RTV 11 functions as the encapsulant between the underside of the glass superstrate and a rear protective sheet of 0.8 mm thick TEXTOLITE. The semi-flexible portion of each shingle module is a composite laminate construction consisting of outer layers of B.F. Goodrich FLEXSEAL and an epichlorohydrin closed cell foam core. The average measured maximum power output of the 52 modules produced during this development program was 5.80 watts at 1 kw/m² insolation and at 28°C. This translates into an areal specific power output of 98 watts/m² of module area at Standard Operating Conditions which includes a calculated nominal operating cell temperature of 61°C with the modules mounted on an insulated roof surface. This high specific power output can be attributed to the efficient packing of the circular cells within the hexagon shape and to the enhancement of the output due to the reflected light from the embossed glass pattern in the white interstices.

42595 Investigation of thin film cadmium sulfide/mixed copper ternary heterojunction photovoltaic cells. Loferski, J.J.; Shewchun, J.; Roessler, B.; Beaulieu, R.; Piekoszewski, J.; Gorska, M.; Chapman, G. (Brown Univ, Providence, RI). pp 190-194 of IEEE photovoltaic

specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

This paper is a preliminary report on a research program whose aim is to fabricate thin film heterojunction solar cells in which one of the constituents is n-type CdS and the other is a p-type alloy of ternaries of the type $CuInSe_2$, $AgInS_2$, etc., so chosen that its lattice constant is exactly equal to the lattice constant of CdS and its energy gap is in the vicinity of 1.5 ev. The paper describes the rationale for using such ternary alloy semiconductors as constituents of thin film cells and shows how to select the lattice constants and energy gaps of semiconductors of this alloy system independently. It describes the results of synthesis of about thirty such alloys and presents iso-energy gap and iso-lattice constant maps for two of these systems. Preliminary experiments aimed at producing thin films of such materials are also described.

42596 Candidate low-cost processing sequence for terrestrial silicon solar cell panel. Bickler, D.B.; Gallagher, B.D.; Sanchez, L.E. (Calif Inst of Technol, JPL, Pasadena). pp 241-245 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The manufacturing sequence discussed in this paper is presented as one which can be utilized in the near term (in the 1970s). It is intended to produce at a rate of 20 megawatts per year, working 24 hours per day.

42597 Silicon solar cells, a manufacturing cost analysis. Grenon, L.A.; Coleman, M.G. (Motorola Inc, Phoenix, Ariz). pp 246-251 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A detailed cost analysis of solar cell module manufacturing, utilizing process sequences incorporating near-term technology, has been performed. The entire structuring of a factory to manufacture solar cell modules, starting from supplied polycrystalline silicon and other raw materials, was specified. This analysis then formed the basis for a sensitivity analysis of the major cost factors. The results of the cost and sensitivity analyses are presented.

42598 1982 low cost photovoltaic module factory study. Carbajal, B.G. (Tex Instrum Inc, Dallas). pp 252-256 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

An analysis of a 1982 Solar Photovoltaic Factory was made to determine the feasiblity of achieving a $2.00 per watt selling price in 1982. A secondary aim of this study was to identify specific cost barriers that might lie in the path of meeting this goal. The study assumed a starting price for polycrystalline silicon of $25/kg and an expected lifetime of at least 20 years for modules deployed in the field. No other constraints were required. The study concluded that an aggressive goal oriented program could achieve the target price with a production rate in the range of 25-30 Mw per year.

42599 Evaluation of options for process sequences. Wolf, M.; Goldman, H.M.; Lawson, A.C. (Univ of Pa, Philadelphia). pp 271-280 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A method is being developed for comparing competing processes for manufacturing photovoltaic solar energy systems. The evaluation involves process economic analyses, energy consumption, and environmental effects of the process options. Early analyses have been carried out for the energy consumption in the arc furnace reduction of SiO_2, for the costs and energy consumption in the Czochralski crystal pulling and various slicing processes, both as exercised presently and with predictable improvements, and for the total energy consumption of the process sequence through the completed module. The latter case has been carried out for the currently used process sequence, but including estimates where detailed data are not available, for a process sequence likely to be in production line use in 1982, and, in a preliminary way, for a process sequence which holds promise for potential use in 1986. While the energy consumption per unit module areas would decrease by a factor of three through the anticipated changes until 1986, it will be necessary to pay more attention to energy consumption in the process steps from ribbon or sheet to finished cells in order to achieve further energy savings.

42600 Silicon ribbon technology assessment 1978-1986. A computer-assisted analysis using PECAN. Kran, A. (IBM, Syst Prod Div, Hopewell Junction, NY). pp 344-349 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Based upon recent significant achievements (e.g., 10 cm wide ribbon; >11% efficient cell), it is believed that /50/m^2 silicon sheet can be obtained with capillary action shaping technology by 1986 without further scientific breakthrough. /25/m^2 silicon ribbon by 1986 still requires significant technology advances. A set of technology requirements has been defined, which results in ribbon prices ranging from /13/m^2 to /30/m^2. Since ribbon geometry objectives (10 cm wide, 0.3 mm thick) have been achieved, short-range technology development will focus on improving material quality (long-range objective: 13% cell efficiency) and increasing growth rate (objective: 3.8 m/hr). Semiconductor grade polysilicon must be available by 1986 at /10/kg for low-cost photovoltaics to become reality.

42601 Multiple silicon ribbon growth by EFG. Mackintosh, B.H.; Surek, T.; Kalejs, J.P.; Sachs, E.M.; Wald, F.V.; Nagy, S. (Mobil Tyco Sol Energy Corp, Waltham, Mass). pp 350-357 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The background and progress to date of edge-defined film-fed ribbon growth for solar cell applications are briefly reviewed. The design and operation of a multiple ribbon-per-operator manufacturing system are then described. Results are presented of cost studies of this system at three stages of development. In the latter stage, believed to be attainable by 1986, conversion costs for polycrystalline silicon into wafers are attained which are consistent with manufacture of photovoltaic systems at $0.50 per peak watt. Principal technological problems in the ribbon growth process are discussed.

42602 Computer modeling of dendritic web growth processes and characterization of the material. Seidensticker, R.G.; Kothmann, R.E.; McHugh, J.P.; Duncan, C.S.; Hopkins, R.H.; Blais, P.D.; Davis, J.R.; Rohatgi, A. (Westinghouse Electr Corp, Pittsburgh, Pa). pp 358-362 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

High area throughput rate will be required for the economical production of silicon dendritic web for solar cells. Web width depends largely on the temperature distribution on the melt surface while growth speed is controlled by the dissipation of the latent heat of fusion. Thermal models were developed to investigate each of these aspects, and were used to engineer the design of laboratory equipment capable of producing crystals over 4 cm wide; growth speeds up to 10 cm/min were achieved. The web crystals were characterized by resistivity, lifetime and etch pit density data as well as by detailed solar cell I-V data. Solar cells ranged in efficiency from about 10 to 14.5% (AM-1) depending on growth conditions. Cells with lower efficiency displayed lowered bulk lifetime believed to be due to surface contamination.

42603 Impact of defects on the photovoltaic potential of RTR silicon ribbon. Baghdadi, A.; Gurtler, R.W.; Legge, R.N.; Ellis, R.J.; Sopori, B.L. (Motorola Inc, Phoenix, Ariz). pp 363-369 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Silicon ribbon growth at a high rate by the ribbon-to-ribbon (RIR) method contains a variety of defects and can exhibit an unusual dendritic morphology. This paper is a study of the effect of the defect structure and dendritic morphology on the photovoltaic potential of RTR ribbon. Defects found in RTR ribbon include grain boundaries, twin planes, stacking faults and dislocations. The electrical activity of these defects is investigated by measuring the diffusion length in the ribbon; by fabricating small area diodes on the ribbon and evaluating their photo-response; and by using a scanning electron microscope in the electron beam induced current mode. It is concluded that although grain boundaries serve very effectively as recombination centers, they do not occur frequently enough in RTR ribbons to significantly affect the generation current. Dislocation densities up to /approximately $10^6/cm^2$ can be tolerated without strongly reducing the photoresponse. Similarly, linear boundaries such as twin planes or stacking faults do not affect the cell performance up to densities of /approximately equals/10^3 cm.

42604 Development of a process for high capacity-arc heater production of silicon. Reed, W.H.; Meyer, T.N.; Fey, M.G.; Harvey, F.J.; Arcella, F.G. (Westinghouse Electr Corp, Power Circuit Breaker Div, Trafford, Pa). pp 370-375 of IEEE photovoltaic spe-

cialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The realization of low cost, electric power from large-area silicon, photovoltaic arrays will depend on the development of new methods for large capacity production of solar grade (S. G.) silicon with a cost of less than $10 per kilogram by 1986 (established Department of Energy goal). The objective of the program is to develop a method to produce S. G. silicon in large quantities based on the high temperature-sodium reduction of silicon tetrachloride ($SiCl_4$) to yield molten silicon and the coproduct salt vapor (NaCl). Commercial a.c. electric arc heaters will be utilized to provide a hyper-heated mixture of argon and hydrogen which will furnish the required process energy. The reactor is designed for a nominal silicon flow rate of 45 kg/hr (100 lb/sub m/hr). Analyses and designs have been conducted to evaluate the process and complete the intial design of the experimental verification unit.

42605 Photovoltaic properties of reactively sputtered Cu/sub x/S films and reactively sputtered Cu/sub x/S—CdS heterojunctions. Armantrout, G.A.; Yee, J.H.; Fischer-Colbrie, E.; Leong, J.; Miller, D.E.; Hsieh, E.J.; Vindelov, K.E.; Brown, T.G. (Univ of Calif, Lawrence Livermore Lab). pp 383-392 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The use of sputtering techniques as an attractive means of fabricating low-cost thin film solar cells have been studied for the Cu/sub x/S-CdS heterojunction system. Control of the Cu/sub x/S stoichiometry uses variable partial pressures of H_2S in a reactive sputtering mode with excellent results. Measured optical absorption spectra, film resistivity, and x-ray diffraction analysis verify the consistent formation of chalcocite. TEM electron diffraction studies indicate epitaxial formation of the reactively sputtered Cu/sub x/S on CdS consistent with a measured interface recombination velocity, S/sub I/, of $2*10^6$ cm/sec. Cell forward and reverse I-V characteristics are also dominated by tunneling processes, as has been observed for wet-dip Cu/sub x/S-CdS heterojunctions. Measured minority carrier diffusion lengths, L/sub e/, of /greater than or equivalent to/ 1000 A in the Cu/sub x/S, coupled with significant red response of heterojunction cells, verify the suitability of reactively sputtered Cu/sub x/S for efficient cell fabrication. Cell efficiencies of 4% have been obtained and are limited at present by technological factors including cell shorting and surface roughness problems.

42606 Formation and properties of cuprous sulfide for thin film CdS/Cu_2S photovoltaic devices. Baron, B.; Catalano, A.W.; Fagen, E.A. (Univ of Del, Inst of Energy Convers, Newark). pp 406-411 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The growth of Cu_2S produced by solution reaction is linear in time. The rate is proportional to cuprous ion concentration and is strongly affected by agitation of the solution. The growth rate is 300 A/sec under the conditions which lead to high efficiency (>8%) solar cells. The cuprous sulfide stoichiometry is diminished by the presence of di-valent copper during growth and superficial oxidation subsequent to film growth. There is a quantitative equivalence between non-stoichiometry and oxide. Cu_2S grown by the solid state reaction is chemically and electrically indistinguishable from that formed by the solution reaction. Cu_2S grown by ion-exchange with solution is inhomogeneously distributed on the CdS substrate, preferentially decorating grain boundaries, cracks and pores in the CdS layer. The non-conformal formations of Cu_2S enhance the photovoltaically inactive junction area. Cu_2S formed by the solid state reaction replicates more closely the CdS topography so that junction area approximates the CdS surface area.

42607 Photon loss analysis of thin film CdS/Cu_2S photovoltaic devices. Bragagnolo, J.A. (Univ of Del, Inst of Energy Convers, Newark). pp 412-416 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Analysis of the short-circuit current losses in the Cu_2S/CdS thin film solar cell is essential for assessing device performance and design limits. The key factor determining the short-circuit current is the photon absorption rate in the Cu_2S layer. Diffuse reflectance spectrometry is the technique best suited for optical analysis of highly structured polycrystalline thin films. Total reflectance spectra for the complete cell and its constitutive layers have been measured using a 4 π integrating sphere. Using these data and a simple optical model, a quantitative loss analysis has been developed and applied to various cell designs. For the strongly textured cell with an SiO/sub x/ anti-reflection cover, the analysis shows that the major photon losses are caused by grid shading (4%), absorption in the metal substrate (10%) and reflection (5%). Based on the analysis, ways to increase conversion efficiency by loss minimization are discussed.

42608 Achievement of 9.15% efficiency in thin film CdS/Cu_2S solar cells. Barnett, A.M.; Bragagnolo, J.A.; Hall, R.B.; Phillips, J.E.; Meakin, J.D. (Univ of Del, Inst of Energy Convers, Newark). pp 419-420 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Thin film photovoltaic solar cells based on cadmium sulfide/copper sulfide have been developed which have energy conversion efficiencies in direct sunlight up to 9.15%. The development of these high-efficiency solar cells was based on analysis of the losses of 7.8% cells first reported at the 12th IEEE Photovoltaic Specialists' Conference. Design changes were based on the application of the loss minimization technique which led to the development of technology which selectively corrected the losses in the conversion of sunlight directly into current, and reduced the power losses at the maximum power point. This paper describes the technique utilized to analyze the losses, the technology developed to selectively correct these losses and the first results of solar cells fabricated based on this design. Further application of this loss minimization technique predicts that solar cell design changes, along with technology development, can lead to thin film cadmium sulfide photovoltaic solar cells with more than 10% energy conversion efficiency in direct sunlight.

42609 Self-supporting silicon films for terrestrial applications by energy beam plasma. Sarma, K.R.; Gurtler, R.W.; Baghdadi, A.; Cota, M.; Ramsey, C.W. (Motorola Inc, Phoenix, Ariz). pp 466-471 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A new method based on an energy beam, for depositing polycrystalline silicon films with efficient material utilization and high through-puts is described. The Energy Beam system is an rf device which produces plasma beams at one atmospheric pressure. Trichlorosilane is reduced by hydrogen in the 4300K Energy Beam plasma and silicon is deposited onto molybdenum substrates. Material efficiencies and growth rates as high as 70% and 10 μm/min have been realized to date. The deposited silicon films are separated from the temporary, reuseable molybdenum substrates using the Thermal Expansion Shear Separation (TESS) technique. Large area self-supporting silicon films are produced using these techniques and they are characterized for their morphology, microstructure and chemical purity. These films are ideal feed-stock for silicon sheet growth by the RTR technique ribbon-to-ribbon technique.

42610 Growth, evaluation and modeling of silicon-on-ceramic solar cells. Zook, J.D.; Schuldt, S.B.; Maciolek, R.B.; Heaps, J.D. (Honeywell Inc, Corp Mater Sci Cent, Bloomington, Minn). pp 472-478 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The silicon-on-ceramic (SOC) process uses inexpensive ceramic substrates to provide supported growth of silicon from the melt. This paper discusses some aspects of SOC crystal growth, presents evidence that SOC layers can produce solar cell quality material, and shows that slotted substrates can be used to make adequate low resistance contacts to the base region. A lumped series resistance model is used to derive the relationship between slot spacing and electrical efficiency, accounting for resistance components which are unique to the SOC approach.

42611 Pd_2Si-(Pd)-Ni-solder plated metallization system for silicon solar cells. Coleman, M.G.; Pryor, R.A.; Sparks, T.G. (Motorola Inc, Phoenix, Ariz). pp 597-602 of IEEE photovoltaic specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The rationale and application of a plated metal system, Pd_2Si-Pd-Ni-solder, is presented. This metallization system is particularly useful on shallow p-n junction solar cells. The advantages of such plated solar cell contacts are discussed. A process sequence for applying the metallization system is outlined. A specific example is presented, including chemical plating solution formulations and detailed process step descriptions. Electrical test data for solar cells metallized with the palladium-nickel-solder system are provided.

42612 Evaluations of candidate encapsulation designs and materials for low-cost silicon photovoltaic arrays. Gaines, G.B.; Carmichael, D.C.; Sliemers, F.A.; Brockway, M.C.; Bunk, A.R.; Nance, G.P. (Battelle, Columbus Lab, Ohio). pp 615-619 of IEEE photovoltaic

specialists conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The 1986 objectives of the Department of Energy's Low-Cost Solar Array (LSA) project are to develop the technology and manufacturing capability to produce 500,000 kw/year of photovoltaic arrays at a cost of less than $500/kW, with an efficiency of greater than 10 percent and a service life of 20 years. One of the tasks (Encapsulation Task) of this project is concerned with the development and evaluation of the protective encapsulation-material systems which will be required to meet these cost and lifetime objectives, as well as the production and performance objectives, for terrestrial photovoltaic arrays. A summary is given of a study which involved the experimental evaluation of selected encapsulation designs and materials based on an earlier study of prior world experience with photovoltaic arrays in the field and with service behavior of encapsulation materials for photovoltaic and related applications.

42613 Optimization of the geometrical parameters for arrays of tracking solar collectors to give minimum energy cost. Masden, G.W. (Walla Walla Coll, College Place, Wash). pp 797-803 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The effect on the cost of energy due to shadowing produced by neighboring collectors on a typical collector in an array is investigated. A cost-performance equation giving a relative cost of energy in terms of collector geometry, array geometry and configuration, collector tracking method and cost parameters of the collector and land is developed. The cost-performance equation is evaluated for a number of tracking methods for collectors having rectangular and circular apertures. For a given tracking method optimum collector and array geometrical relationships exist which minimize the cost of energy produced. Collector arrays that perform at minimum energy cost can be expected to operate with shadows a significant period of the day. The converter system must be designed to be least affected by shadowing.

42614 Some failure modes and analysis techniques for terrestrial solar cell modules. Shumka, A.; Stern, K.H. (Calif Inst of Technol, JPL, Pasadena). pp 824-834 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

This paper describes the types of failure modes observed in failed/defective silicon solar cell modules of various types and procured from different manufacturers. This paper also describes analytical techniques that are particularly useful diagnostic tools for performing failure analysis.

42615 Environmental qualification testing of terrestrial solar cell modules. Hoffman, A.R.; Ross, R.G. Jr. (Calif Inst of Technol, JPL, Pasadena). pp 835-842 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The placement of solar cell modules in various climates and locations throughout the world results in different degrees and combinations of environmental stresses. Coupled with a design lifetime goal of 20 years, early detection and correction of module design deficiencies can result in significantly better long-term economics. This paper describes an environmental test research program for developing qualification requirements and procedures for falt-plate solar cell modules. A multiple iterative approach for establishing and evaluating test requirements is discussed as well as the rationale for the selection of levels and durations for the qualification tests. The status of study efforts involving optical surface soiling, encapsulation delamination, and voltage bias-humidity testing is reviewed.

42616 Variation of solar cell sensitivity and solar radiation of tilted surfaces. Klucher, T.M. (NASA, Lewis Res Cent, Cleveland, Ohio). pp 847-852 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

An empirical study was performed to evaluate the validity of various insolation models used to compute solar radiation incident on tilted surfaces from global data measured on horizontal surfaces and to determine the variation of solar cell sensitivity to soalr radiation over a wide range of atmospheric condition. Evaluation of the insolation data indicates that the isotropic sky model of B. Liu and R. Jordan underestimates the amount of solar radiation falling on tilted surfaces by as much as 10%. An anisotropic-clear-sky model proposed by R. Temps and K. Coulson was also evaluated and found to be deficient under cloudy conditions. A new model was formulated which reduced the deviations between measured and predicted insolation to less than 3%. Evaluation of solar cell sensitivity data indicates small change (2-3%) in sesitivity from winter to summer for tilted cells. The feasibility of using such global data as a means for calibrating terrestrial solar cells as done by F. Treble is discussed.

42617 Progress towards high efficiency polycrystalline thin-film GaAs AMOS solar cells. Yeh, Y.C.M.; Ernest, F.P.; Stirn, R.J. (Calif Inst of Technol, JPL, Pasadena). pp 966-971 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Recently, single-crystal GaAs AMOS (Antireflecting Metal-Oxide-Semiconductor) solar cells have been reported to achieve an energy conversion efficiency of up to 17% for a fully gridded AR-coated cell. One of the most promising features of an AMOS structure is its adaptability to polycrystalline thin-film solar cells for terrestral solar energy conversion in which the cost is the primary concern. Energy conversion efficiency of 14% under AM1 illumination (ELH lamp) has been observed with an AMOS solar cell made on the sliced polycrystalline GaAs wafer with an average grain size of 100 μm by 100 μm. An energy conversion efficiency of 8% (4.8% without antireflection coating) has been realized with an AMOS solar cell made on CVD GaAs/recrystallized Ge/W substrate. Details of problems associated with the recrystallization and GaAs film growth are presented.

42618 Solar photovoltaic intermediate power system operating strategies and economic considerations. Pittman, P.F.; Chowaniec, C.R. (Westinghouse Electr Corp, PIttsburgh, Pa). pp 1010-1015 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Applications of solar photovoltaic intermediate power systems were studied ranging in peak power output from 100 kW to 10 MW. The two applications found most primising were a proprietor owned system serving a commercial load, and a small utility owned substation. Comparative cost/performance analyses were made for a system with a peak power output of 500 kW owned either by a proprietor or a utility. The proprietor owned system could obtain a discounted cash flow return on investment of 15% in 10 years if solar cells costing $100/kW with an efficiency of 10% were used. The utility owned system, co-located with a battery load leveling plant, can attain a favorable cost/benefit ratio with solar cells of the same cost and efficiency.

42619 Photovoltaic design optimization for terrestrial applications. Ross, R.G. Jr. (Calif Inst of Technol, JPL, Pasadena). pp 1067-1073 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A comprehensive program of module cost-optimization has been carried out. The objective of these studies has been to define means of reducing the cost and improving the utility and reliability of photovoltaic modules for the broad spectrum of terrestrial applications. This paper describes one of the methods being used for module optimization, including the derivation of specific equations which allow the optimization of various module design features. The method is based on minimizing the life-cycle cost of energy for the complete system. Comparison of the life-cycle energy cost with the marginal cost of energy each year allows the logical plant lifetime to be determined. The equations derived allow the explicit inclusion of design parameters such as tracking, site variability, and module degradation with time. An example problem involving the selection of an optimum module glass substrate is presented.

42620 Fixed angle and seasonably adjustable structural support concepts for solar converters. Masser, P.S.; Keeling, M.C.; Lesk, I.A. (Motorola Inc, Phoenix, Ariz). pp 1084-1089 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A number of solar array structural support types for the next generation of solar modules have been evaluated, and currently available units surveyed to determine the most cost effective approaches. These structural support concepts include residential, intermediate, and large scale arrays, but are limited to fixed angle and seasonal adjustment capability. A configuration study was conducted in which possible panel and support structures were morphologically categorized. The resulting combinations were used to select the

following support concepts: truss, frame, gunite, concrete slab, inflatable, treated plywood, direct attachment to (or integral part of) a structure. Computerized parametric cost estimates are presented for the truss and frame. Construction cost tables were used to estimate costs (or savings) for the other concepts. The designs reflect particular needs of solar devices (e.g., periodic cleaning, and sub-array replacement). One interesting large area concept (particularly suitable in the Southwest) is combining array supports with high tension power line supports and/or array placement on adjacent right of way.

42621 Thin film polycrystalline silicon solar cells. Chu, T.L.; Chu, S.S.; Stokes, E.D.; Lin, C.L.; Abderrassoul, R. (South Methodist Univ, Dallas, Tex). pp 1106-1110 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Thin film polycrystalline silicon solar cells have been prepared by the deposition of a silicon film of 25-30 μm thickness containing a p-n junction of partially purified and recrystallized metallurgical silicon substrates. The dopant profile in the surface region of the solar cells was graded to provide a drift field, the substrate was of low resistivity to provide a back surface field, and vapor deposited tin dioxide was used as the antireflection coating. Solar cells were characterized by current-voltage, spectral response, and effective diffusion length measurements. At present, the best cells (9-10 cm^2 area) have an AM1 efficiency of about 9.5% at room temperature.

42622 Epitaxial solar cells on low-cost silicon substrates. Robinson, P.H.; D'Aiello, R.V.; Richman, D.; Faughnan, B.W. (RCA Lab, Princeton, NJ). pp 1111-1115 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

This work is directed toward a low-cost approach to the fabrication of silicon solar cells and combines the advantages and flexibility of the epitaxial technique with the use of potentially low-cost silicon substrates. Epitaxial graded base $n/p/p^+$ solar cell structures were grown and evaluated on various forms of polycrystalline and metallurgical grade silicon as well as single crystal substrates. X-ray topographic techniques have shown improvements in the crystallographic quality of the layer grown on polycrystalline material. AM-1 efficiencies of 13.5% have been reproducibly obtained for single crystal solar cell structures less than 1 mil thick, while an efficiency of 10.6% has been achieved using a metallurgical grade silicon substrate with the same epitaxial layer profile.

42623 Front surface field solar cell, a new concept. von Roos, O.; Anspaugh, B. (Calif Inst of Technol, JPL, Pasadena). pp 1119-1120 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The "front surface field" (FSF) solar cell design consists of a wafer of P type silicon containing a P-N junction on the rear surface and a P^+ layer on the front surface. The junction consists of interdigitated strips of N^+ material and ohmic contacts at the rear surface. There are no current collection grids nor busbars on the front surface, allowing current collection and cell contacting on the rear surface only. This design is similar to the tandem junction cell. In the case of the FSF cell however, the built in electric fields of both the N^+-P and of the P^+-P junctions point in the same direction, reinforcing each other and therefore facilitating the minority carrier (electron) current collection at the N^+-P depletion layer edge. Furthermore, the blue response of the cell is greatly enhanced since the free carriers generated close to the front surface are driven toward the N^+-P junction by the built in electric field.

42624 Regional analysis of residential photovoltaic system concepts. Kirpich, A.S.; Buerger, E.J.; Chan, T.S.; Fogaroli, R.P.; O'Brien, G.P.; Tully, G.F. (GE, Space Div, Valley Forge, Pa). pp 1171-1178 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Conceptual designs of photovoltaic (PV) systems have been prepared for residences which reflect floor areas, architectural styles and energy conservation features applicable to median-income families in various regions of the United States during the coming decade. Detached and multi-family units are being considered. Roof-mounted PV arrays are being studied in conjunction with solar thermal collection systems which provide heat for space conditioning and domestic hot water. The attractiveness of these system options is being assessed in terms of economic competitiveness for twelve designated regions of the U.S. representing a broad spectrum of climatic characteristics. Performance analyses are being conducted for each design option using hourly weather data from SOLMET tapes for a representative site within each region.

42625 Analysis of photovoltaic total energy system concepts for single-family residential applications. Chobotov, V.; Siegel, B. (Aerosp Corp, El Segundo, Calif). pp 1179-1184 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Analysis procedures and results are presented comparing the cost and performance of photovoltaic total energy systems designed to meet the thermal and the electrical demands of typical residences in Phoenix, Arizona, and Madison, Wisconsin. The three system concepts that are investigated use a) photovoltaic panels only, b) separate thermal and photovoltaic panels, or c) combined photovoltaic/thermal panels. Only flat plate roof-mounted collectors are considered, and it is assumed that any required backup energy is purchased from the local utility. The minimum levelized annual cost to the homeowner is determined as a function of photovoltaic array cost. Optimum panel areas and storage capacities are obtained, for different energy backup costs and capital recovery factors, for each of the system concepts.

42626 Response of defects to illumination in silicon solar cells. Hari Rao, C.V.; Bell, R.O.; Cretella, M.C.; Ho, J.C.; Wald, F.V.; Ravi, K.V. (Mobil Tyco Sol Energy Corp, Waltham, Mass). pp 1213-1219 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The enhancement of diffusion length with intensity was examined using spectral response measurements in solar cells based on Silso non-single crystalline cast silicon and edge-defined film-fed growth (EFG) silicon ribbon. Local diffusion length variations at defect sites were investigated as a function of illumination level using a scanning electron microscope operated in the electron beam induced current mode. An increase of diffusion length was observed at defect sites as the intensity level was increased. The diffusion length improvements are explained on the basis of saturation of minority carrier traps in these materials. The trap distribution in Silso silicon is shown to be peaked near (E$sub c$ - 0.7)e. EFG silicon ribbon shows a broad, Gaussian distribution of traps located near (E$sub c$ - 0.5)ev.

42627 Thin tandem junction solar cell. Chiang, S.; Carbajal, B.G.; Wakefield, G.F. (Tex Instrum Inc, Dallas). pp 1290-1293 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A silicon solar cell device structure was designed to improve performance from thin (<100 μm) cells. The cell has junctions on both the illuminated and the non-illuminated sides (n^+pn^+ structure). The photoresponse I-V performance of cells was measured in two modes, with either collection from junctions on both sides, or collection from only the non-illuminated side. In the latter case, the front junction is open. The open n^+p junction eliminates front surface recombination by confining light generated carriers in the base region. For the back collection mode, carrier confinement can also be achieved with a p^+p front junction. This p^+pn^+ structure is called a front surface field cell. Experimental data in terms of cell performance, the effect of thickness, lifetime and light bias, as well as further improvement of the cell are discussed.

42628 Development of high-efficiency p^+-n-n^+ back-surface-field silicon solar cells. Fossum, J.G.; Nasby, R.D.; Burgess, E.L. (Sandia Lab, Albuquerque, NM). pp 1294-1299 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The design and fabrication of high-efficiency p^+-n-n^+ back-surface-field (BSF) silicon solar cells are described. The technological development of the cells has been advanced by an analytical study of the pertinent device physics. This study has provided the identification and characterization of the primary physical mechanisms that can limit the solar cell performance, and has henceforth led to near-optimum BSF cell designs. Power-conversion efficiencies of nearly 17% at AM1 and greater than 18% at illuminations near 50 suns have been measured at 27°C. The cell fabrication process is straightforward and is characterized by exceptionally high yield.

42629 Study of the effective resistance of the diffused layer and its effect on solar cell performance. Tung, Y. Columbia, SC; Univ. of South Carolina (1978). 123p. University Microfilms Order No. 7907638.

Thesis (Ph. D.).

The series resistance associated with the solar cell has been proven to be a limiting factor on the conversion efficiency. The contribution from the diffused layer to the total series resistance is analyzed using a numerical method. It is found that the relationship between the current and the voltage in the diffused layer is nonlinear; consequently, the electrical behavior of this layer cannot be described by a resistance of constant value. This not only makes it impractical, in most cases, to analyze the characteristics of a solar cell from a lumped-element circuit model, but also hinders the design of the contact pattern since the effective resistance of the diffused layer is closely related to the geometry of the pattern. A more realistic approach for synthesizing the solar cell design is proposed using unit fields as building blocks. Since the total power output from a cell can be derived from that of the constituent unit fields, the performance of the cell as a whole can be predicted once the current and voltage characteristics of the unit field are known. A procedure is described which enables one to accomplish this through the construction of the I-V curves of each unit field.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 42286, 42494, 42506, 42516

42630 (HCP/T4101—01) **Design of a pilot silvicultural biomass farm at the Savannah River Plant.** Salo, D.J.; Henry, J.F.; Inman, R.E. (Mitre Corp., McLean, VA (USA)). Mar 1979. Contract EG-77-C-01-4101. 132p. Dep. NTIS, PC A07/MF A01.

Metrek has designed a detailed plan for the establishment and operation of a 1000-acre silvicultural biomass farm at the Savannah River Plant, Aiken, South Carolina. The plan includes a discussion of possible sites, layout and design, and installation and operation. The estimated costs of installation and operation are also presented.

42631 (NP—23689) **Current awareness bulletin, July—August 1978.** (Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.; National Board for Science and Technology, Dublin (Ireland)). Nov 1978. 118p. Dep. NTIS (US Sales Only), PC A06/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

42632 (NP—23696) **Current awareness bulletin, October—December 1977.** (National Science Council, Dublin (Ireland). Energy Group; Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.). Mar 1978. 159p. Dep. NTIS (US Sales Only), PC A08/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

42633 (NP—23702) **Current awareness bulletin, October—December 1976.** (National Science Council, Dublin (Ireland). Energy Group; Institute for Industrial Research and Standards, Dublin (Ireland). Technical Information Div.). Mar 1977. 92p. Dep. NTIS (US Sales Only), PC A05/MF A01.

This is a literature survey. The abstracts are divided into five classifications: forestry products, animal wastes, crop residues, domestic and urban wastes, and general and review topics. (MHR)

42634 (TID—29400/1) **Sugar crops as a source of fuels. Volume I. Agricultural research. Final report.** Lipinsky, E.S.; Kresovich, S.; McClure, T.A.; Jackson, D.R.; Lawhon, W.T.; Kalyoncu, A.A.; Daniels, E.L. (Battelle Columbus Labs., OH (USA)). 31 Jul 1978. Contract W-7405-ENG-92-077. 222p. Dep. NTIS, PC A10/MF A01.

This report by Battelle Columbus Division presents the results of a study of the feasibility of using sugar crops as a source of fuels. The program is a cooperative effort, including universities, USDA field experiment stations, research organizations, and engineering companies. Narrow-row spacing experiments were conducted at Houma, Louisiana; Baton Rouge, Louisiana; and Belle Glade, Florida. Narrow-row spacing promotes more rapid canopy closure which helps a short season location more than a long season location. Sweet sorghum experiments in Texas, Louisiana, Mississippi, and Ohio indicate favorable yields compared with sugarcane, and yield increases with close spacing in all areas. The project team concludes that sweet sorghum has considerable fuel potential, based on its ability to grow wherever corn or soybeans grow. Initial evaluation of the Tilby cane separator process, which separates the pith from the rind fiber without crushing and grinding, indicates that the process is promising as a means of obtaining fermentable sugars at low cost. The advantages of the Tilby process (yet to be demonstrated on a commercial scale) are low energy consumption, high value for the rind fiber coproducts in products that perform like plywood, pulp or paper making, and ability to use high fiber sugarcane or sweet sorghum.

42635 (TID—29401) **Production of sugarcane and tropical grasses as a renewable energy source. Third quarterly report, December 1, 1977—February 28, 1978.** (Center for Energy and Environment Research, Mayaguez (Puerto Rico)). 1978. Contract EG-77-G-05-5422. 55p. Dep. NTIS, PC A04/MF A01.

Tropical grasses from Saccharum and related genera are being evaluated as candidates for intensive production of solar-dried biomass. Categories of candidate grasses include short, intermediate, and long-rotation crops for co-production with conventional food commodities. The hybrid forage grass Sordan 70A (Northrup King Seeds) is the outstanding short-rotation plant tested to date. Napier grass (var. Common Merker) is a promising intermediate-rotation crop which possibly may be exceeeded by several napier grass hybrids. Candidate clones from the Saccharum species sinense and spontaneum are being investigated for use in both long-rotation and minimum-tillage production regimes. Direct comparisons of sugarcane hybrids with napier grass indicate that sugarcane is an inferior candidate for tropical forage production. Sugarcane responded well to narrow row centers at 2 months but the response diminished at 4 and 6 months. For both crops, greater biomass yields were obtained from a single harvest at 6 months than from three 2-month harvests combined. The ability to convert early succulent growth to dry matter is a decisive feature for candidates to be handled as frequently-recut forages. Progress has been made in chemical growth regulation studies. A series of intergeneric hybrid clones are being imported for evaluation as biomass sources. Limited progress was made in biomasscandidate breeding. A revised work plan for year 2 is discussed.

42636 (TID—29427) **Production of sugarcane and tropical grasses as a renewable energy source. First quarterly report, June 1—August 31, 1978.** Alexander, A.G.; Garcia, M.; Gonzalez-Molina, C.; Ortiz-Velez, J. (Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station). 1978. Contract ET-78-S-05-5912. 83p. Dep. NTIS, PC A05/MF A01.

Tropical grass experiments in progress at the close of Year 1 were completed. Final data confirm that napier grass is superior to sugarcane in dry matter production when harvested at 2-, 4-, and 6-month intervals, but sugarcane is superior when harvested only once at 12 months. Sugarcane yields were vastly increased as the growth period was extended from 6 to 12 months but the opposite response was obtained with napier grass. Sugarcane produced the highest DM yields of Year 1, ranging from 22 to 27 tons/acre, of which some 3 to 6 tons were collected trash (desicated and detached leaf material-formerly burned prior to harvesting operations). The highest napier grass yield was 25.6 tons/acre (combined yield of two 6-month harvests). Screening studies on tropical grasses were continued with short and intermediate rotation candidates. Evaluations of common napier grass and two PI napier hybrids were also completed. Four S. spontaneum clones and PR 980 were propagated for 6 months with minimal fertilizer and water inputs (100 lbs N/acre, 6 acre inches of water). The highest yield, about 11 dry tons/acre (of which 4 tons were trash), was produced by the S. spontaneum clone US 67-22-2. The reference clone, PR 980, was significantly less productive at 9 tons/acre.

42637 **Marine algae and aquatic plants as food components.** Mitsui, A. Miami, FL; University of Miami (1977). 41p. (CONF-771158—2).

From Seminar on microbial conversion systems for food and fodder production and water management; Kuwait City, Kuwait (12 Nov 1977).

Limits on land-based food and feed production are outlined and the advantages of marine resource utilization summarized. The possibilities for new research development in the utilization of the oceans and coastal areas for food and feed production are then examined in a detailed review. Marine photosynthetic resource culture is discussed with respect to the cultivation and harvesting of marine photosynthetic organisms, their use in aquaculture, nutrient supply, solar energy bioconversion efficiency, and the utilization of marine photosynthetic products as food and feed. Research needs are discussed with respect to the survey of organisms with utilization potential and the enhancement of production capability. The need for international research coordination and education is stated. (JSR)

42638 **Waste wood as an energy source in New England.** Gay, L. (Stove Works, Brattleboro, VT). pp 291 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42639 **Wood energy overview.** Page, A. pp 19-23 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42640 Controlled swamps for food and fuel. Brown, J.G. (Granger Filter Inc., Andover, MA). pp 283-286 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The prime objective shall be to develop an Algae Biomass fuel system that might produce 10 Quads per year (10% of U.S.A. needs) by the year 2000 at $2.00 per million Btu for an investment of $100 billion. A specific system involves the transport of most of Southwestern Californian sewage over 100 miles to Edwards Dry Lake to form a 40-square mile algae growing and water purifying lagoon and a separate 120-square mile storage lake. On top of this storage lake will be floated a high growth rate, recycled nutrient rich solution, for maximum algae growth. The system will include algae drying and burning at the site to produce electrical energy. This power plant then provides the CO_2, particulate nutrients, and fixed nitrogen needed by the algae.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 42493, 42495, 43252, 43551

42641 (COO—4546-6) Improved Fe_2O_3 photoelectrochemical cell. Final report of innovative research program subtask, December 1977—September 1978. Job, R.C.; Kelleher, P.J. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 8p. Dep. NTIS, PC A02/MF A01.

The objectives of this project were to develop an improved photoelectrochemical cell utilizing a polycrystalline Fe_2O_3 semiconductor electrode. Various metal oxide impurities were doped into the electrode using relatively simple, direct methods. The stability of the cell as well as its energy conversion efficiency and response to the solar spectrum were studied. It was shown that doping of the semiconductor electrode in a PEC can have a favorable effect on both performance and on response. The effect seems not only to increase photocurrent but also to shift the flatband potential, as evidenced by an increase in photovoltage. In addition, it has been noted that FeS_2 shows a large improvement over Fe_2O_3. Results are presented and discussed. (WHK)

42642 (NP—23493) Project results: solar energy-photochemical conversion and storage. Claesson, S.; Engstroem, L. (eds.). (National Swedish Board for Energy Source Development (NE), Stockholm). 1977. 373p. Dep. NTIS (US Sales Only), PC A16/MF A01.

A comprehensive survey of presently available photochemical conversion and storage processes is presented and future lines of development are discussed. The seven chapters deal with the following topics: (1) general considerations of solar energy conversion possibilities and the role of solar energy conversion in future energy provision; (2) solar energy and photoinduced redox processes: general principles; (3) photoelectrochemical production of electricity; (4) photoinduced redox processes: production of hydrogen and other fuels; (5) photochemical production of hydrogen catalyzed by metal complexes; (6) chemical conservation of solar energy by photoreduction of carbon dioxide; and (7) photochemical solar energy conversion in organized systems.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 42563, 42587, 42618, 43158, 43159, 43160, 43162

42643 (HCP/R4024—01/14) Satellite power system (SPS) preliminary societal assessment. Bloomquist, C.; Daurio, A.; Shotland, S. (PRC Energy Analysis Co., Los Angeles, CA (USA)). May 1979. Contract EG-77-C-01-4024. 69p. Dep. NTIS, PC A05/MF A01.

The findings of fourteen papers dealing with SPS societal issues have been digested and are presented. While numerous societal problems and potential concerns are delineated, no program stoppers have been identified. Thus, in so far as the societal ramifications of an SPS are concerned additional study of the concept is warranted. Societal topics which merit particular attention in the future are delineated. These include rectenna site availability, utility integration, and institutional/international considerations. Study findings that might be used in a comparative assessment of the SPS with alternative energy systems are presented. Methodological considerations for future SPS societal research are also discussed.

42644 (N—79-11475) Satellite power systems (sps) concept definition study (exhibit c). Quarterly review no. 2. Hanley, G.M. (Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry). Sep 1978. Contract NAS8-32475. 446p. NTIS PC A19/MF A01.

A coplanar satellite conceptual approach was defined. This effort included several trade studies related to satellite design and also construction approaches for this satellite. A transportation system, consistent with this concept, was also studied, including an electric orbit transfer vehicle and a parallel-burn heavy lift launch vehicle. Work on a solid state microwave concept continued and several alternative approaches were evaluated. Computer determination of an optimized transistor and circuit design was also continued. Experiment/verification planning resulted in the development of a total solar array and microwave technology development plan, as well as definition of near-term research to evaluate key technology issues.

42645 DOE/LeRc photovoltaic systems test facility. Cull, R.C.; Forestieri, A.F. (NASA, Lewis Res Cent, Cleveland, Ohio). pp 22-26 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The DOE/LeRC Photovoltaic Systems Test Facility was designed and built and is being operated by the NASA Lewis Research Center, Cleveland, Ohio, as a national facility to serve the needs of the entire DOE National Photovoltaic Program. The objective of the facility is to provide a place where photovoltaic systems may be assembled and electrically configured, without specific physical configuration, for operation and testing to evalulate their performance and characteristics. The facility as a "breadboard" system allows investigation of operational characteristics and checkout of components, subsystems and systems before they are mounted in field experiments or demonstrations. The facility as currently configured consists of 10 kw (peak) of solar arrays built up from modules from several manufacturers, two inverter test stations, a battery storage system, interface with local load and the utility grid, and instrumetation and controls necessary to make a flexible operating facility. Expansion to 30 kw (peak) is planned for 1978. Test results and operating experience are summarized to show the variety of work that can be done with this facility.

42646 Status of the DOE photovoltaic systems engineering and analysis project. Jones, C.J.; Schueler, D.G. (Sandia Lab, Albuquerque, NM). pp 1160-1165 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

The economic viability of photovoltaic power systems depends not only on the reduction of photovoltaic array prices but also on the realization of acceptable total installed system price. The allowable total installed system price is calculated for various major application sectors, based on a range of projected energy costs. These allowable prices are then compared to projected prices which are obtained by examining the current and future expected prices of the major subsystems comprising an operational system. Based on this comparison an assessment of the status of the major subsystem technologies, exclusive of the photovoltaic array, is given and areas requiring emphasis are identified.

42647 Central station power plant applications for photovoltaic solar energy conversion. Leonard, S.L. (Aerosp Corp, El Segundo, Calif). pp 1190-1195 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

Previously reported technical and economic analyses of utility (central station power plant) applications for photovoltaic solar energy conversion have been extended to take into account a) the use of concentrator systems, b) operation in many parts of the U.S., c) effects of recent revisions of the insolation data base, and d) regional variations in the cost of fossil fuel. It is tentatively concluded that flat-plate photovoltaic plants with $100-300/k arrays will probably be economically competitive in most parts of the U.S. by the year 2000 but that systems with high or medium concentration will require that most of the thermal energy be used profitably in order to be competitive anywhere in the U.S. prior to the 2000 time period.

42648 Effects of design on cost of flat-plate solar photovoltaic arrays for terrestrial central station power applications. Tsou, P.; Stolte, W. (JPL, Calif Inst of Technol, Pasadena). pp 1196-1201 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

This paper focuses on the impact of module and array designs on the balance-of-plant costs for flat-plate terrestrial central station power applications. Life-cycle cost of a 20-year plant life serves as the costing criteria for making design and cost trade-offs. This paper

contributes in establishing a tailored code of accounts to permit the determination of consistent photovoltaic power plant costs and in providing credible photovoltaic system cost baselines for flat-plate module and array designs by costing several varying array design approaches.

42649 Design of the Natural Bridges National Monument 100 kw pv power system. Lyon, E.F.; Bucciarelli, L.L.; Benoit, A.E. (MIT Lincoln Lab, Lexington, Mass). pp 1268-1271 of IEEE photovoltaic specialist conference. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

A 100 kw peak photovoltaic (PV) power system for the Natural Bridges National Monument (NBNM) in southeastern Utah scheduled to become operational in mid-1979, will convert sunlight into dc electrical power, store all or part of the accumulated energy in a large battery bank, and supply ac power to the NBNM site through the use of a main inverter. It is expected that the site demand will run from 10 to 40 kw. In addition, certain critical PV system ac loads will be supplied from an uninterruptable power source inverter. Since there is no electric utility service for NBNM, nor is a hookup planned, a diesel-powered generator will serve as a backup for the PV system during periods of reduced solar energy.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 42668, 42734

42650 (SAND—78-1894C) **Midtemperature Solar Systems Test Facility (MSSTF) system test results, winter season.** Harrison, T.D.; McCulloch, W.H. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 12p. (CONF-790541—9). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The testing of a solar energy system under winter conditions at the DOE/Sandia MSSTF is reported. The purpose of the test is stated. The equipment, weather, and procedures are described. Test results are tabulated and discussed. Problems are identified and quantified.

CENTRAL RECEIVER

42651 (DOE/TIC—10103) **Materials testing for central receiver solar—thermal power systems.** Majumdar, S. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

The program described is concerned with the determination of specific elevated-temperature mechanical properties of materials used for critical components in solar control receiver power systems. The first task is concerned with the biaxial creep-fatigue testing of Type 316H stainless steel superheater tubing. The second task involves a comprehensive survey of available information on sodium effects on candidate materials for solar—thermal electric piping and steam generators. The third task is concerned with mechanical-properties data generation in support of the ASME code development. The status of the project is described. (WHK)

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 43141, 43158, 43159, 43160, 43162

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 42498

42652 (CONF-780550—9) **OTEC-1 test conductor program.** Archbold, P.; Bates, J.O. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 1978. Contract EY-76-C-03-0700. 13p. Dep. NTIS, PC A02/MF A01.

From Seminar on testing solar energy materials and systems; Washington, DC, USA (22 May 1978).

The involvement of the Test Director Contractor (TDC) in the OTEC-1 test program is outlined, considering the preparation for and testing of the initial test heat exchangers and auxiliary equipment. The following are discussed: interfaces, TDC/SIC (Systems Integration Contractor) test relationship, test request, test procedures, data handling, and biofouling laboratory. (MHR)

42653 (CONF-790459—2) **Thermodynamic assessment of OTEC open-cycle power systems.** Chen, F.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

The thermodynamic process of the open cycle is presented and the recent power system studies on the subject are summarized. Based on the range of operating parameters that have been established in the recent system design studies, an optimal thermal performance model is developed. The modeling results for the case studied indicate that low flashdown temperature and higher water velocity in smooth condenser tubes maximize the net power per unit condenser heat transfer surface area.

42654 (COO—4459-2) **Foam sea solar power plant. Progress report, July 1, 1977—April 20, 1978.** Fort, T.; Fetkovich, J.; Greenstein, M.; Lara, P.; Meier, D.; Zener, C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 30 Apr 1978. Contract EG-77-S-02-4459. 41p. Dep. NTIS, PC A03/MF A01.

The air injection generator described in the last report has made possible quantitative measurements which are reported. The significance of these measurements is discussed. It appears that foam generated at low rates, < 0.2 grams/cm^2 sec, has high resistance to deformation; foam generated at high rates, > 0.35 gram/cm^2 sec, has negligible resistance to deformation. In this latter case all the loss is associated with the wall effect, varying essentially as the velocity squared. The high resistance to deformation of slowly formed foam is interpreted to arise solely from dehydration during its formation. Dehydrated foam is simply stiffer than moist foam. Since the measurements were taken, a major technical advance in foam breaking has been made. It was found that an anionic foam is broken simply by a cold water spray of tap water. The literature on the flow resistance of foam was studied. The application of this flow resistance data to observations was reported. Good agreement was obtained with slowly generated foam. It appears that the foam previously worked with was dehydrated. From this work on the flow of foam in the vertical pipe the conclusion is that by going to sufficiently large diameter pipes, resistance to flow will become negligible. Progress in the construction of a foam column is reported on which will give more precise measurements, and in which these measurements will be automated. Such automated precise measurements will be of great use in sorting out the effects of the various parameters. The concept of mutually anihilating foam and contra-foam is developed. Such a concept has the potential of greatly simplifying the breaking of foam in an OTEC plant.

42655 (DOE/ET—0083) **Ocean systems. program summary.** (Department of Energy, Washington, DC (USA). Office of Solar, Geothermal, Electric and Storage Systems). Feb 1979. 260p. Dep. NTIS, PC A12/MF A01.

This program summary describes each of the DOE's Ocean Systems Program projects funded during FY 1978 (October 1, 1977 through September 30, 1978) and reflects their status as of September 30, 1978. The Ocean Systems Program includes ocean thermal energy conversion, wind—wave energy, ocean current energy, and salinity gradient energy. The project summary sheets list the project title, contractor, principal investigator, work location, contract number, DOE funding, and project summary. (WHK)

42656 (HCP/T2898—01/1) **OTEC thermal resource report for Ivory Coast.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 36p. Dep. NTIS, PC A03/MF A01.

The thermal resource off the Ivory Coast is quite good for OTEC purposes. There are consistently large ΔT (surface temperature—temperature at depth) values throughout the year. The mean ΔT at 1000 meters is approximately 22°C. A mean annual ΔT of 20°C can be reached at a depth of only 600 meters. The thermal resource for the coldest month of the year is also adequate at 600 meters. Water 1000 meters deep is available within 35 kilometers from the shore. The waters south of the Ivory Coast do not have a particularly good mixed layer depth. Strong winds and tropical storms are a rare occurrence. Similarly, the sea and swell conditions do not present a problem for OTEC development in this area. Currents are generally moderate, although occasional periods of weak currents less than 1/4 knot can be expected. The consistently large thermal resource without major environmental problems recommends this location as a potential OTEC site.

42657 (HCP/T2898—01/2) **OTEC thermal resource report for Sri Lanka.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 37p. Dep. NTIS, PC A03/MF A01.

The water surrounding the island of Sri Lanka has a temperature difference resource which is more than adequate for potential OTEC use. The temperature resource was examined between 5—10° North latitude and 78—83° East longitude. This area includes the surrounding waters on all sides of Sri Lanka. There is a large area north and northwest of the island where there is insufficient depth to

provide the needed cold water supply. The annual average ΔT at 1000 meters is 21.3°C. An annual average ΔT greater than 20°C is available at 800 meters. The temperature is very consistent at depths with little difference between the coldest monthly mean temperature and the warmest. The area has an upper mixed layer the entire year, (deepest in January—February and shallowest in the fall). Winds and storms are not a major problem for this site, although there are occasional tropical storms or hurricanes. Low to moderate sea and swell conditions generally dominate throughout the year. The surface currents are generally moderate throughout the year, changing direction with the shifting monsoons.

42658 (HCP/T2898—01/4) **OTEC thermal resource report for Mombassa.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 46p. Dep. NTIS, PC A03/MF A01.

The coastal waters off Mombassa, Kenya were selected for study for their potential for Ocean Thermal Energy Conversion (OTEC) use. The area examined is located in the southwestern equatorial region. The data file was searched between 40—45° East longitude and between 5° South latitude and 3° North latitude. The area south of the equator was examined separately from the area north of the equator. A usable thermal resource exists for both the northern and southern sections examined. The Mombassa site compares unfavorably with most of the other 10 sites studied under this contract if ΔT is used as the only criteria. An annual average ΔT of 20°C is not reached until a depth of 1100 meters in the northern section, and at 1000 meters in the southern section. The average of the monthly mean ΔTs at 500 meters is 17.0°C in the north section and 17.6°C in the southern section. The thermal resource is definitely better in the southern position. There is a mixed layer throughout the year that is advantageous for OTEC development. Winds and storms are not a problem for the site. Low sea and swell conditions are characteristic. Surface current conditions are fairly complicated. The distance from shore to the 1000 meter depth varies, depending on what latitude is chosen for the site. One thousand meter depths are between 30 and 130 kilometers (≈ 18 and 70 nautical miles) from land.

42659 (HCP/T2898—01/5) **OTEC thermal resource report for Western Coast Mexico.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 44p. Dep. NTIS, PC A03/MF A01.

The site chosen for study off the western coast of Mexico between 20—23° North latitude, 105—110° West longitude has a temperature difference resource which is more than adequate for potential OTEC use. The annual mean ΔT to 1000 meters is 20.9°C. An annual mean ΔT of 20.0°C is available at 800 meters. The monthly mean ΔT for the coldest month of the year is 17.2°C; at 800 meters while there is some variation in the monthly mean temperature difference, even the coldest month is adequate. The mixed layer depth is very shallow throughout the entire year. Storms are a problem for this area between May and November. Low sea and swell predominate throughout the year. The surface currents are generally weak to moderate with some variation in direction during the year. The continental shelf is fairly wide for most of the region making the distance to shore from depths of 1000 meters somewhat large. There is one bay from which deep water can be reached within 5 kilometers.

42660 (HCP/T2898—01/6) **OTEC thermal resource report for Dampier Land, Australia.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 38p. Dep. NTIS, PC A03/MF A01.

The region off Dampier Land, Australia was selected for study as a potential OTEC site. The region examined was between 13—18° South latitude and 118—121° East longitude. Data coverage was sparse, but the existing data demonstrated a fine potential for Ocean Thermal Energy Conversion (OTEC) use. The maximum temperature gradient remains relatively stable throughout the year. The annual average ΔT at 1000 meters is 22.6°C. At 600 meters, an annual average ΔT greater than 20°C is obtainable. The continental shelf off Dampier Land is very wide; thus, the distance to water 1500 meters deep may be as much as 480 kilometers (260 nautical miles). Water 1000 meters deep lies at least 265 kilometers (143 nautical miles) offshore. This distance is a major problem, perhaps necessitating the use of a plant ship. Tropical storms can be a problem between December and April. The ocean off Dampier Land has an upper mixed layer throughout the year. Currents are generally moderate, although the surface circulation pattern changes during the year.

42661 (HCP/T2898—01/7) **OTEC thermal resource report for Guam.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 33p. Dep. NTIS, PC A03/MF A01.

The temperature difference resource of Guam is unsurpassed among the ten sites studied under the present contract. The monthly mean surface temperatures are consistently high throughout the year, ranging from 27.7 to 29.2°C. Consistently large ΔT values are available throughout the year, with small variability. An annual average ΔT greater than 20°C is available at depths of slightly less than 500 meters. Potential OTEC sites off Guam would require cable lengths of less than 9.3 kilometers (5 nautical miles) in many locations. Waters 500 meters deep are within 3.7 kilometers (2 nautical miles) off parts of Guam. Typhoons and tropical storms (with associated high seas and strong winds) are problems at the Guam site. Currents are generally moderate in strength with little variation in direction. Guam has airfields and harbors available for logistic support. Seismic activity in the area also poses a potential threat to OTEC operations.

42662 (HCP/T2898—01/8) **OTEC thermal resource report for Manila, Philippine Islands.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 37p. Dep. NTIS, PC A03/MF A01.

An examination of the historical oceanographic data for the waters off Manila, Philippines shows that there is an excellent thermal difference resource for OTEC purposes. The region examined was between 14—16°N latitude and 118—120°E longitude, which is off the west coast of the island of Luzon. Surface temperatures are high the year round, with the lowest monthly mean surface temperature being 27.2°C. The average of the monthly mean ΔTs to 1000 meters is 24.0°C. At 500 meters, the annual thermal difference resource is 20.0°C, so that the cold water pipes can be relatively short. The continental slope off the Philippines is steep, and water depths of 1000 meters lie within 18.5 km (ten nautical miles) off the shores of Luzon. There is an adequate upper mixed layer throughout the year. Typhoons are a major problem for this area. High winds and storms are a bigger problem for this site than any other site studied under the current contract. Seismic activity also occurs. Currents are generally moderate with some variation during the year.

42663 (HCP/T2898—01/9) **OTEC thermal resource report for Jakarta, Indonesia.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 40p. Dep. NTIS, PC A03/MF A01.

The thermal resource south of Jakarta, Indonesia was studied for the area between 6—9° South latitude and 104—109° East longitude. The available thermal resource is an excellent one for OTEC exploitation. The mean surface temperature is very high, above 28°C. An average monthly ΔT of 22.8°C is available at a depth of 1000 meters. An annual average ΔT greater than 20.0°C is available at 650 meters. Mean monthly temperatures at depths greater than 400 meters do not vary by more than 1°C. The distance from the south coast of Java to the 1000- and 1500-meter depths is not prohibitive, with depths of 1000 meters available in less than 20 kilometers. The necessary depths to provide an adequate cold water supply are not available north of the island. The distance from Jakarta, on the north west coast of the island to water 1000 meters deep is quite large. A mixed layer exists throughout the year with small seasonal variation. High winds and storms are not major problems for OTEC development or operation. Surface circulation is fairly complex with variations throughout the year. Seismic activity is a problem for this site.

42664 (HCP/T2898—01/10) **OTEC thermal resource report for Caribbean Sea Plant Ship 13—15°N 75—80°N.** Wolff, W.A. (Ocean Data Systems, Inc., Monterey, CA (USA)). May 1979. Contract ET-78-C-01-2898. 41p. Dep. NTIS, PC A03/MF A01.

A large and consistent thermal resource exists in the area between 13—15° North latitude and 75—80° West longitude, which was studied for possible use by a plant ship. The area studied is primarily in the Colombian Basin of the Caribbean Sea. The average annual ΔT (surface temperature minus temperature at depth) for the area at 1000 meters is 22.4°C. At 650 meters, an adequate ΔT exists, with no month of the year having a mean ΔT less than 19°C. The total variability of temperature at all depths in this Caribbean area is small. Below 1000 meters, the total variation is extremely small. The area has a good mixed layer at all times of the year. It is occasionally exposed to strong winds from hurricanes. Currents generally show the same general pattern throughout the year with a predominant flow toward the west or northwest at average speeds of 40—50 cm/sec.

42665 (LBL—8967) **Assessment and control of OTEC ecological impacts.** Wilde, P.; Sandusky, J.; Jassby, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 20p. (CONF-781109—29). Dep. NTIS, PC A02/MF A01.

From Environmental control symposium; Washington, DC, USA (28 Nov 1978).

Ecologically sound operations of projected Ocean Thermal Energy Conversion (OTEC) plants can be insured by careful attention to the marine environment during the design phase. This requires quality information from regions of potential OTEC interest.

Currently, preliminary or actual surveys and laboratory studies are being conducted in the waters of Puerto Rico, the Gulf of Mexico, Hawaii, and Guam for potential moored OTEC plants and in the equatorial South Atlantic for proposed plant—ship operations to provide such benchmark and baseline data. These data plus existing archival information can be used to model effects of OTEC operations based on projected design schemes. Four areas of concern: (1) redistribution of oceanic properties; (2) chemical pollution; (3) structural effects; and (4) socio-legal-economic; and 11 key issues associated with OTEC deployment and operation have been identified. In general, mitigating strategies can be used to alleviate many deleterious environmental effects of operational problems as biostimulation and outgassing. Various research studies on toxicity and biocide releases are under way or are planned to investigate areas where no clear mitigating strategy is available. A Master Plan listing procedures to be followed to identify and evaluate potential concerns at any OTEC proposed site is proposed for discussion and refinement in advance of any real OTEC test operations.

42666 (ORO—4918-11) **Use of mixtures as working fluids in ocean thermal energy conversion cycles. Phase II. Final report, August 15, 1976—February 28, 1978.** Starling, K.E.; Johnson, D.W.; Hafezzadeh, H.; Fish, L.W.; West, H.H.; Iqbal, K. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1978. Contract EY-76-S-05-4918. 53p. Dep. NTIS, PC A04/MF A01.

During Phase II of this research program, the following elements of research have been performed: (1) the thermodynamic properties of ammonia, water and ammonia-water mixtures have been correlated in the range of conditions applicable to OTEC cycles, (2) the OTEC cycle simulator OTEC-3 was modified so that ammonia-water mixtures could be used as working fluids, (3) a working fluid recycle loop was added around the evaporator, (4) a first pass optimization program was developed for use in OTEC cycle design, (5) a sensitivity analysis was performed on the OTEC ammonia cycle in order to provide an optimized base case for later comparison with ammonia-water cycles, (6) a preliminary correlation of the transport properties of ammonia-water mixtures was selected, based on literature correlations, (7) a preliminary investigation of the effects of water leakage on ammonia cycle heat transfer coefficients was performed, (8) an investigation of the overall effects of water leakage on an ammonia OTEC cycle was performed, and (9) an initial optimization was made for an OTEC cycle using an ammonia-water mixture as the working fluid.

42667 (TID—29444) **Corrosion and biofouling of OTEC system surfaces: design factors. Final report. Technical report 868.** Jenkins, J.F. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Nov 1978. 58p. Dep. NTIS, PC A04/MF A01.

Biofouling and corrosion of Ocean Thermal Energy Conversion (OTEC) plants are critical factors in the economic feasibility of the OTEC concept. As the mission and operating requirements of an OTEC plant are significantly different than those for any existing facility, many unique materials and design problems must be addressed. Factors that influence biofouling and corrosion are identified, specific design features are recommended where appropriate, and items requiring further investigation are identified. 71 references.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 42551, 42768, 42819

42668 (SERI/TP—69-221) **Proceedings: solar thermal power user review panel meeting.** (Solar Energy Research Inst., Golden, CO (USA)). Mar 1979. Contract EG-77-C-01-4042. 33p. Dep. NTIS, PC A03/MF A01.

Selected SERI presentations are reviewed briefly. Synopses of discussions of target audience needs are included. The Solar Thermal User Review Panel and the meeting agenda are listed. (MHR)

42669 (TAC-STHC—78-002) **Solar thermal heating and cooling. Quarterly update, April—June 1978. Bibliography with abstracts.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). 1978. 69p. Technology Application Center, Univ. of New Mexico, Albuquerque, NM.

Citations are presented on the following subjects: system overviews; computer models, demonstration; thermal storage; architectural consideration; passive solar energy; thermal load computations; domestic water heating, insolation and instruments; swimming pools; and greenhouses. Author and permuted title/keyword indexes are included. (MHR)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 42553, 42624, 42727, 42770, 42820, 43237

42670 (BMFT-FB-T—78-48) **Investigation on the applicability of technical systems utilizing solar energy for the heat supply of buildings of the German Federal Army.** Holbl, J.F.; Krack, H. (Gesellschaft fuer Wirtschaftliche Bautechnik m.b.H., Muenchen (Germany, F.R.). Inst. fuer Angewandte Bauforschung). Jul 1977. 239p. (In German). Dep. NTIS (US Sales Only), PC A11/MF A01.

Standardized army buildings were analyzed considering possibilities for installation of technical systems utilizing solar energy for water and space heating. A skeleton analysis on 4 categories of buildings was accomplished with evaluation of preliminary results received. Continuing investigation of the building type proved appropriate, including a preliminary optimization of essential technical components, considering of climate, construction and use parameters. For the 4 categories analyzed, the optimum results for installation of solar heating systems will be achieved in troop accommodation buildings. Considering different modifications in standard, reduction of costs of energy will be achieved in a scale of about 40% to 55% for each object, depending on type, use, and locality. It is recommended to install 4 equal solar systems in 2 equal buildings with flat roof, and 2 equal buildings with pitched roof, in order to obtain comparable data.

42671 (COO—4546-1) **Analysis of a LiCl open-cycle absorption air conditioner which utilizes a packed bed for regeneration of the absorbent solution driven by solar heated air. Final report of Innovative Research Program Subtask, December 1977—September 1978.** Leboeuf, C.M.; Loef, G.O.G. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 32p. Dep. NTIS, PC A03/MF A01.

The technical feasibility of lithium chloride open cycle absorption air conditioner which utilizes solar heated air for reconcentration of the absorbent solution is examined. This study involves the use of a packed bed concentrator. Solar heated air is used to reconcentrate the solution by vaporizing water (the refrigerant) from the solution in the packed bed, thus enabling the system to be incorporated into a conventional solar air-heating system and avoiding numerous problems associated with the roof concentrator. Operating conditions for a 3-ton residential unit are determined from equilibrium data, conservation of mass and energy, and transfer rate equations. Humidity, air temperature, and packing type are varied to determine their effect on packed bed performance and required packing volumes. Based on the results of this analysis, it appears that the required operating temperatures, humidities, and flow rates are comparable to those which can be obtained from a conventional solar air-heating system during the summer, especially in dry climates. Construction and testing of a packed bed of appropriate design is recommended for validation of the analysis.

42672 (COO—4546-4) **Preliminary analysis of a total solar heating system. Final report of Innovative Research Program Subtask, December 1977—September 1978.** Leflar, J.A.; Burns, P.; Winn, C.B. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 28p. Dep. NTIS, PC A03/MF A01.

An innovative research grant concerning long-term storage in solar heating systems was initiated in 1977 at Colorado State University. The principal purpose of this innovative research project was to develop a methodology by which one could design Total Solar Heating Systems (TSHS) and determine the feasibility of such systems. As a result of this innovative research project, a set of computer simulation programs has been developed in a manner such that these programs provide a very useful design tool for the design of total solar heating systems. During the second phase of this project experimental studies relating to the long-term storage aspects of a total solar heating system will be conducted. During the third phase of the project the simulation program will be used for the purpose of designing the total solar heating system and it is planned that during the fourth phase a total solar heating system will be constructed at the Solar Energy Applications Laboratory at Colorado State University. The fifth and final phase of the project will be devoted toward the monitoring of the performance of the TSHS and validation of the design programs.

42673 (DOE/CS—0083) **Workshop manual on technical, economic and legal considerations for evaluating solar heated buildings for lenders, appraisers, insurers, and tax consultants.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Mar 1979. 253p. Dep. NTIS, PC A12/MF A01.

A broad picture of the present energy situation (world wide and in the U.S.) is provided with special emphasis on the present and future role of solar energy in that scenario. The technical aspects of solar space heating and domestic hot water systems are described. Distinctions are made between passive and active systems and oper-

ation of each system is described in layman's language. Differences between liquid and air systems are described and comparisons are provided. The factors about which lenders, appraisers and insurers should be cognizant in their evaluation of solar-equipped buildings are identified. Current data are provided on costs of the original equipment, expenses associated with the maintenance and operation of the equipment and the energy savings that can be expected through its usage. A description of legal and insurance factors is included with special emphasis on solar easements, zoning, and safety hazards. Barriers and incentives to solar energy use for heating buildings are described. The procedures that lenders and insurers can use in evaluating solar properties, including life-cycle analysis, are described.

42674 (DOE/NASA/CR—161191) **Test and evaluation of Fern Engineering Company, Inc., solar heating and hot water system.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1979. Contract EX-76-A-29-1037. 26p. Dep. NTIS, PC A03/MF A01.

Tests, test results, examination and evaluation by Underwriters Laboratory, Inc., on Fern Engineering Company's solar heating and hot water system are included. The system consists of the following subsystems: collector, storage, control, transport, and data acquisition. Two single family solar heating and hot water prototype systems have been installed at Lansing, Michigan, and Tunkhannock, Pennsylvania.

42675 (DOE/NASA/CR—161204) **Prototype solar heating and cooling systems. Monthly progress reports.** (AiResearch Mfg. Co., Torrance, CA (USA)). Apr 1979. Contract EX-76-A-29-1037. 49p. Dep. NTIS, PC A03/MF A01.

This report is a combination of monthly progress reports submitted by AiResearch Manufacturing Company. It contains a summary of activities and progress made from November 1, 1978, to February 28, 1979. AiResearch Manufacturing Company is developing prototype solar heating/cooling systems under NASA Contract NAS8-32091. This effort calls for the development, manufacture, test, system installation, maintenance, problem resolution, and performance evaluation.

42676 (EPRI-ER—845) **Performance monitoring of an off-peak heating and cooling system utilizing thermal storage and solar augmented heat pump.** Moreland, W.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Apr 1979. 39p. Dep. NTIS, PC A03/MF A01.

This interim report describes the instrumentation system (including sensors and data logging equipment) used in the demonstration system. A general description is also given of the modes of operation of the main heat pump/storage/solar system, the proposed methodology and format for data reduction, and the present status of the program.

42677 (HCP/M4113—03) **Passive solar design: an extensive bibliography.** (AIA Research Corp., Washington, DC (USA)). Dec 1978. Contract EG-77-C-01-4113. 218p. Dep. NTIS, PC A10/MF A01.

This bibliography is divided into two parts: by subject and by author. Part A is divided into twenty-one subject matter categories each with entries listed alphabetically according to the title. Part B is alphabetically listed according to author. (MHR)

42678 (LA-UR—79-1337) **Simple procedure for assessing thermal comfort in passive solar heated buildings.** Wray, W.O. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-790541—5). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The Fanger thermal comfort equation is linearized and used to develop a procedure for assessing thermal comfort levels in passive solar heated buildings. In order to relate comfort levels in nonuniform environments to uniform conditions, a new thermal index called the equivalent uniform temperature is introduced.

42679 (N—79-11477) **Optimum dry-cooling sub-systems for a solar air conditioner.** Chen, J.L.S.; Namkoong, D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1978. 41p. NTIS PC A03/MF A01.

Dry-cooling sub-systems for residential solar powered Rankine compression air conditioners were economically optimized and compared with the cost of a wet cooling tower. Results in terms of yearly incremental busbar cost due to the use of dry-cooling were presented for Philadelphia and Miami. With input data corresponding to local weather, energy rate and capital costs, condenser surface designs and performance, the computerized optimization program yields design specifications of the sub-system which has the lowest annual incremental cost.

42680 (SAN—1590-1/3) **Development of a high temperature solar powered water chiller. Volume 3. Phase I technical progress report, September 26, 1977—June 1, 1978.** English, R.A. (Carrier Corp., Syracuse, NY (USA). Energy Systems Div.). Jun 1978. Contract EG-77-C-03-1590. 121p. Dep. NTIS, PC A06/MF A01.

This section describes the conceptual design rationale and resulting design configuration as well as providing estimates of cost and performance. Because the development of the turbo-compressor design paralleled the development of the chiller system design, all of the cost and performance data are based on intermediate turbo-compressor performance data, as well as on unoptimized components. Optimized performance was computed at the very end of Phase I, and only a brief comparison is made to show the potential gains available. Updating of all the predicted performance data for the final conceptual design will await Phase II.

42681 (SAN—1590-1/4) **Development of a high temperature solar powered water chiller, Volume 4. Phase 1 technical progress report, September 26, 1977—June 1, 1978.** English, R.A. (Carrier Corp., Syracuse, NY (USA). Energy Systems Div.). Jun 1978. Contract EG-77-C-03-1590. 150p. Dep. NTIS, PC A07/MF A01.

The performance of the high temperature solar powered water chiller was evaluated in a solar system. Three climatic regions were selected for the evaluation which represent significant variations in heating to cooling ratio. Typical multi-family and commercial building constructions were selected for each location, and building load files created using the TRNSYS program. Solar system components were selected on a preliminary basis and simulation models were prepared for each, including the chiller. Component cost and total system cost data were developed for economic trade-off studies. It is intended, under this contract, to evaluate various system configurations to determine which best interfaces with the solar driven Rankine unit, both from a performance and economic standpoint. Preliminary parametric studies were begun to identify the best type of system and best component sizing for a commercial building in two cities. Some prelimanry annual performance data have been obtained and related to conventional equipment performance.

42682 (SAN—1592-1) **Cost-effective control systems for solar heating and cooling applications. Final report.** Pejsa, J.H.; Bassett, W.W.; Wenzler, S.A.; Nguyen, K.H.; Olson, T.J. (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Sep 1978. Contract EG-77-C-03-1592. 180p. Dep. NTIS, PC A09/MF A01.

A methodology has been defined to arrive at control recommendations for a variety of climate control system designs, applications and regions, and the results are presented in two parts. Part I consists of a literature and market-place survey, involving control strategies, functions, sensors, actuators, and the controllers themselves. Part II represents the bulk of the study effort - an attempt to simulate and evaluate system performance for several representative residential and commercial heating and cooling designs and thus to derive improved performance techniques within cost-effective control systems. (MHR)

42683 **Method and structure for solar heating.** Milburn, W.W. Jr. US Patent 4,147,300. 3 Apr 1979. Filed date 8 Dec 1976. 10p.

A method and structure are disclosed for utilizing solar energy for heating utilizing a wall of masonry or other cementitious material having preferably vertical channels defined through the central portion thereof. An outer surface, preferably spaced from the wall, is provided with a radiant energy absorbing surface, and transparent or translucent panels are positioned adjacent to but spaced from the wall and outer surface. Inlets and outlets to the channels within the wall are defined in the lower inner and outer surfaces of the wall respectively, and outlets and inlets to such channels are defined at the upper inner and outer surfaces of the wall respectively. The inner outlets communicate with an air distribution system and the inner inlets serve as return air ducts. The outer outlets and inlets serve to convect heat from the radiant energy absorbing surface. Preferably, the inner surface of the wall is insulated and, optionally, heat flow paths, preferably of metal, extend through the central portion of the wall including the channels. In particularly advantageous embodiments, supplemental heating means are provided in the heat distribution system. A heat pump may be employed to withdraw heat from the wall thereby greatly extending the amount of available heat energy stored in the wall.

42684 **Solar window unit.** Bergen, B.J. (to Addison Products Co.). US Patent 4,141,337. 27 Feb 1979. Filed date 19 Aug 1977. 6p.

A window unit is disclosed for heating a room with solar heat comprising a heat collector section and a heat storage section. A three position fan directs air either from the collector to the interior, from the collector to the store, or from the store to the interior.

42685 **Residential solar space heating in New Zealand.** Shaw, R.A. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1978). 32p. (NZERDC—39).

The performance characteristics of conventional discrete component solar space heating systems are discussed and economic

evaluation procedures outlined. Computer based dynamic simulations are shown to be a necessity for optimal technical design and meaningful economic analysis. Appendix I contains basic calculations which indicate that conventional systems are not economically viable for Auckland, even with allowance for energy cost escalations. Break-even requires an initial cost of 5.2 c/kWh, escalating over a 20 year period at 5% per annum to 13.8 c/kWh. Two passive solar space heating systems which seem ideally suited to New Zealand conditions are reviewed. The original French Trombe—Michel Solar wall developmental work is summarized in conjunction with important experimental performance data. Australian Trombe—Michel Wall computer simulation work is described. The Window—Floor passive system is briefly outline and design problems highlighted.

42686 Solar house. A guide to solar energy utilization in domestic, industrial and commercial building. Sabady, P.R. Boston, MA; Newnes-Butterworths (1978). 320p.

In addition to the history and economic policy of the principles of solar energy, the problem of using the sun's radiation is examined from the viewpoint of the architect. The different types of solar collector are described and compared and the many different storage methods which can be adopted are analyzed. A separate chapter is devoted to solar buildings already in use in both Europe and the USA. The construction of these installations is fully described and technical performance data relating to them are given. This book is a translation of the well-known Haus und Sonnenkraft. (MHR)

42687 Shaking up the construction industry: strategies to increase the use of solar energy in New England. O'Connor, D. (Center for Energy Policy, Inc., Boston, MA). pp 309-310 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42688 Heat transfer fluid: a solar system's life blood. Krasa, R.P. (Dow Corning Corp., Midland, MI). pp 337-340 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The fluid capabilities, economics, toxicity, stability, scale, decomposition products, fluid cost, and homeowner maintenance requirements are discussed briefly. A heat transfer fluid properties checklist is included. (MHR)

42689 Utility peak-mitigating solar building designs. Sullivan, P.W.; Breese, J.S.; Kohler, J.T.; Anderson, B.N. (Total Environmental Action, Inc., Harrisville, NH). pp 381-384 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

A systematic evaluation to determine an optimum peak mitigating solar building design is described. The methodology for determining the effect of solar building design parameters on consumer and utility economics is presented. A number of building design parameters are systematically varied and their effect on auxiliary energy use quantified. Utility cost of service and revenue calculations and consumer life cycle cost calculations are used to determine the preferred building configuration from consumer, utility, and society perspectives. (MHR)

42690 Use of flat plate solar collectors for high rise buildings. Barker, N.M. (PPG Industries, Pittsburgh, PA). pp 391-392 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42691 Solar heating and cooling for large buildings: a case study. Dubin, F.S. (Dubin—Bloome Associates, New York, NY). pp 393-399 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Air conditioning is required for most commercial buildings in the South, and is the largest single factor contributing to peak electric demand and to the continuing need for more power plants. Yet, while solar domestic hot water heating and solar space heating systems are cost effective in many areas of the country and installations are escalating at a rapid rate, solar cooling systems are not so cost effective and the paucity of installation methods and costs are impeding the development of such systems. The problems and costs encountered for a combined solar cooling and heating system, which is now being installed in the Newport Savings and Loan Association Bank in Newport News, Virginia are described, as compared to a solar domestic hot water and space heating system alone.

42692 Practical approach to passive solar heating. Keller, S.F. pp 401-402 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The advantages of passive solar heating are discussed. The participation of the Kalwall Corporation in a cost sharing demonstration project with ERDA is described briefly. (MHR)

42693 House for all seasons. Gores, L.; Gores, P.W.; Sturges, P.M. pp 403-407 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

More than half of this energy-conserving house is below grade, waterproofed, and earth-insulated. The upper areas have up to ten inches of insulation, triple glazing, and the entrance door opens into an airlock. Solar collectors are provided for water heating. One auxiliary system is a wood burning fireplace. The heat pump uses pre-tempered air which is circulated by a blower through 300 ft. of 24-in. pipe buried deep in the earth. (MHR)

42694 Passive and hybrid solar building design. Watson, D. pp 409-410 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42695 Consumer's four questions. Vittek, J.F. Jr. (Franklin Pierce Law Center, Concord, NH). pp 467-471 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The four questions a consumer may be expected to ask about solar systems are discussed. These questions are: what will solar energy do for me; how much will it cost; is it safe; how do I get one. (MHR)

42696 Hybrid passive systems I: design considerations, theoretical predications and performance of an attached solar greenhouse used to heat a dwelling. Taff, D.C. (Parallax Corp., Charlotte, VT); Holdridge, R.B.; Wolfe, J. pp 43-47 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Passive solar heating can be accomplished in a cost effective manner by attaching a thermally efficient greenhouse to the structure requiring heat. The results of a monitoring study done on such a greenhouse in Hinesburg, Vermont are presented. In this study, the greenhouse was used to heat part of a home. Simulation data is also presented which indicates design improvements required for structures to be thermally productive as well as self-sufficient. Calculations are also presented which indicate potential savings in home heating possible with attached greenhouses located in 12 U.S. cities.

42697 Hybrid passive systems II. Close control design criteria establishing cost effective solar heating - the Hybrid-Delta line. Taff, D.C.; Holdridge, R.B. (Parallax Corp., Hinesburg, VT). pp 49-53 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

One of the major design problems associated with passive solar architecture is a lack of close temperature control within the conditioned space. Although passive designs are often simpler and more cost effective than active systems, any lack of control effects their thermal efficiency as well as their market acceptance. Hybrid systems containing both the passive collector—storage subsystems as well as the close electronic control of active systems offer marked advantages over either alone. Studies have established the solar greenhouse as an effective hybrid passive system. Further work discussed the design parameters of a solar greenhouse used to heat a home. It is shown that the very act of adding close control enhances the climate reliability of the structure and allows the designer/builder the obvious advantage of predicting, within fair limits, future performance.

42698 Passive and controllable passive solar space heating. Magnon, D.M. pp 55-60 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Definitions are given for passive and controllable-passive heating and associated terms. Examples of these low technology systems are used for illustration and conclusions drawn as to their economic feasibility. (MHR)

42699 Design, construction, and performance of a free-standing, energy-conserving, light-enhancing, solar-heated greenhouse in southern Vermont. Coleman, J. (Total Environmental Action, Inc., Harrisville, NH); Hayes, J.; Fuller, D. pp 61-62 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42700 Cortada Library: system performance of vertical wall passive solar collector, Orange, Virginia (private library retrofit). Gottschalk, W.L. (The Rosemary, Orange, VA). pp 63-67 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

A detached single story building converted to a library facility by retired diplomat James N. Cortada was retrofitted with a passive air type collector array placed on the south face of an exterior wall. The 103 square foot array has delivered a substantial fraction of the heat demand of the facility, having a value of about $135 per year in equivalent electrical auxiliary energy at present electrical rates. The solar heating plant meets a requirement of silence within the small building, being passive it uses no mechanical components or rotating machinery. Experience with this project reveals that a very simple solar technology can be delivered at modest cost having significant economic return. Similar applications are recommended where they can be integrated into existing or planned architectural programs.

42701 Design and construction of two energy-conserving, solar-heated greenhouses. Hayes, J.; Bibby, T.; Piserchio, M.; DuPont, W. (Marlboro Coll., VT). pp 69-73 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

An attempt was made to design and construct two greenhouses, which would be maximally insulated and yet provide sufficient light for plant growth, would provide a net heat gain to the structures to which they are attached, and could be constructed at a materials cost of about $5/ft^2. One of the greenhouses has a reflective, insulated, retractable shutter, reflective interior wall surface, and removable insulation under the roof glazing. (MHR)

42702 Enhancement of intrinsic solar heating. Converse, A.O. (Dartmouth Coll., Hanover, NH); Kachadorian, J. pp 75-79 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Green Mountain Homes Solar-Slab building's thermal performance is summarized for the period October 1976—May 1977. Descriptions of the building, and monitoring and data processing procedures are also presented. The measured heat loss for this 1264 ft^2 building was 6.42 Btu/°F-day-ft^2 of living space including insolation, or 4.02 for purchased energy only. 37% of the heating energy came from the sun. The monthly average of the maximum daily temperature ranged from 71.8 to 74.0. The total cost of oil and electricity for heating was $249.

42703 Thermal results of certain passive structures. Saunders, N.B. pp 81-84 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Goals for popular acceptance of passive solar heating are presented. Mistakes made in solar heating are described. Experience with three passive solar houses and the Cambridge School installation is described. (MHR)

42704 Home energy planning: a concept for New England. Chase, H. (Clean Energy Systems, Keene, NH). pp 87-92 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Three concepts in planning are presented: 40 year usefulness of your home energy center, life cycle costing for energy, involvement in energy needs. Possibilities in energy conservation, wood heating, solar heating, and heat pumps are discussed. (MHR)

42705 Energy conservation/solar energy evaluation and design tool. Michal, C.; Pietz, P.; Putnam, B.; Taber, D.; Bremer, D. (Total Environmental Action, Inc., Harrisville, NH). pp 93-96 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

A training manual and working tool for paraprofessional energy conservation workers is described. It includes drawings and specifications of 18 weatherization, energy conservation, and solar energy interventions (called applications) for single-family houses. It also includes methods for gathering information, estimating fuel savings and costs of installation, and for comparative evaluation of the various applications.

42706 Comparison of currently available solar energy system simulation programs. Kohler, J.; Breese, J.; Sullivan, P.; Anderson, B. (Total Environmental Action, Inc., Harrisville, NH). pp 97-100 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Three currently available solar energy simulation programs are compared: TRNSYS, a detailed transient simulation program prepared by the University of Wisconsin Solar Energy Laboratory; f-chart, a correlation based on TRNSYS simulations, also developed at Wisconsin; and, SOLCOST, a simulation, based on average weather data, developed by Martin Marietta Aerospace for ERDA's Division of Solar Energy. The computation algorithms, data requirements, performance, and economic analysis, accessibility, costs and applications of the three programs are discussed.

42707 SOLCOST—a versatile and simple program for the practicing solar system designer. Winn, C.B.; Hull, D.E. (Solar Environmental Engineering Co., Inc., Fort Collins, CO). pp 101-103 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42708 Prediction of the performance of solar heating systems utilizing annual storage. Lunde, P.J. (Center for the Environment and Man, Inc., Hartford, CT). pp 109-113 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Integrated performance equations which incorporate effects of finite storage are derived for solar heating systems such as those using annual storage in which the well-mixed storage temperature rises or falls monotonically. These equations accurately predict in a single step the performance of ordinary systems over an entire day, and annual storage systems over an entire month. Over a year, monthly application of the integrated equations predicted annual performance within about two percent relative to an hourly simulation.

42709 Economic trade-offs between solar heating and energy conservation in residential buildings: a New England perspective. Wirtshafter, R.M.; Carter, C.L. (Clark Univ., Worcester, MA). pp 131-132 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42710 Commercial Solar Retrofit System. Bays, J.T.; Wormser, E.M. (Wormser Scientific Corp., Stamford, CT). pp 135-138 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42711 Integration of liquid based solar collectors and the water to air heat pump. Strong, S.J. pp 140-141 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

An energy system design is described which integrates a water to air heat pump module with direct input from a flat plate solar array to provide full 12-month climate control as well as humidification, dehumidification, domestic hot water and swimming pool heating.

42712 Solar-assisted heat pump with long-term storage. Hewitt, E. (Solar Associates, Hartford, CT); Raman, K. pp 143-147 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The analysis of the conventional solar-assisted heat pump system is extended by incorcorating firstly, long-term storage, and secondly, a dual-source heat pump system. The performance of the system is analyzed in detail, as a function of collector performance characteristics and area, storage volume, heat pump characteristics, load, ambient climatic conditions, solar insolation, and the price of the input energy for the heat pump.

42713 100% solar and wood heated residence in central Maine. Serdy, J.G. pp 166-167 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42714 Cost effective solar heating for a garden apartment village in central New Hampshire. Serdy, J.G.; Strong, S.J. pp 168-169 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42715 Conversion to solar heat. Thomason, H.E.; Thomason, H.J.L. (Thomason Solar Homes, Inc., Washington, DC). pp 171-175 o1 NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Various models of the patented Thomason Solaris heating system are described. The cost, specifications, and results of comparison testing are given. (MHR)

42716 Goosebrook: an energy conserving solar house built on speculation by Total Environmental Action, Inc. Anderson, B.; Michal, C.; Coleman, J. (Total Environmental Action, Inc., Harrisville, NH). pp 177-182 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The two-story, three bedroom house includes 1400 ft^2 of heated space plus a full, insulated basement, an enclosed front entry porch, double car garage and storage loft, a lounging deck, and a greenhouse. Extensive energy conservation measures limit the heating load to about 9300 Btu per degree day. The entire south wall of the first floor is glass. To dampen temperature fluctuations, nine 12-in. dia, seven-foot high tubes of water stand inside the house. The active system combines a site-assembled version of the Thomason-type, open-flow trickle collector with a site-assembled array of 18-in. dia, seven-foot high Kalwall water tubes. (MHR)

42717 Residential solar designs using pyramidal optics solar systems. Mezoff, C. pp 183-190 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The Pyramidal Optics System is a low gain optical solar collection system which uses inexpensive flat mirror surfaces, enclosed in an attic space, to achieve a concentration factor of up to four. This concentration reduces the collector requirement by a factor of four and results in a significant reduction in cost for flat plate receivers and associated plumbing, with less consumption of strategic materials. By placing the absorbers within an attic space, they are protected from rain, ice, snow, and dirt so that the collectors need not be constructed to withstand severe environmental assaults. By reducing the receiver area by a factor of four, the solar flux per unit area is increased by a factor of three, whereas the radiant, conductive, and convective losses, which are proportional to absorber surface area, are not similarly increased. This results in a net improvement in performance.

42718 Doug Kelbaugh house. pp 203-214 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

A passive approach to solar heating using the Trombe (thermal storage) wall technique is utilized in a house in Princeton, NJ, designed, built, and occupied by Doug Kelbaugh and his family. Princeton (located slightly north 40 degrees latitude) normally experiences 5100 heating F-days and receives about 55% of the possible sunshine during the winter. The house design, solar system, later modifications, and performance are discussed. Photographs, drawings, and sample data are included.

42719 Construction and initial system performance of first air type solar installation on a commercial building in Orange, Virginia (retrofitted office building). Gottschalk, W.L. (The Rosemary, Orange, VA). pp 221-224 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The Ober Realty Office Building in Orange, Virginia presented an ideal opportunity for a cost effective solar retrofit exercise. The building is a single story masonry type with concrete slab floor. The flat built-up roof has a gambrel section as an architectural feature at the front. The building insulation is considered good for this 17 year old structure. The 54° and 30° slopes of the rear part of the gambrel face 15° east of south for an operating bias favoring morning demand heating. The existing flat section of roof to the south of the gambrel serves as a reflector to augment collector performance when it is covered with snow or water, Figure 1. The 550 square foot air cooled solar collector array of conventional design was field fabricated with locally obtained materials using local labor. The array was integrated onto the existing roof saving the cost of roof shingles in need of replacement. The ratio of building floor to collector is 4:1.

42720 Report of performance of the Acorn solar heated model house for winters of '75 '76 and '76 '77. Hapgood, W.; Bemis, J.R. pp 225-229 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The performance experience on the instrumented solar heated model house was extended over the now two winters it has been operating and monitored. The monthly performance of the solar system and the house heating system is shown. This data is compiled from the hourly and daily tapes. Some intervals caused by computer shut-downs has to be filled in by estimates. This was done from the meter-read resistance heat input, the degree-day meter readings, and the calculated U/A Btu from adjacent days.

42721 Accurate testing procedures for testing solar heating system performance. Erhartic, P. (Suntap Inc., Bloomfield, CT); Froehlich, J.P. pp 231-234 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The parts of the data acquisition system are discussed including the temperature sensors, energy input and output monitoring, flow meters, time clock, and data logger. (MHR)

42722 Economic results of certain passive structures. Saunders, N.B. pp 235-240 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Economic factors involved in passive solar heating and the hierarchy of decision criteria are outlined. Examples of the economics of structures designed by the author are given. (MHR)

42723 Monitoring solar space heat. Hyman, M. Jr. (Solar Heat Corp., Arlington, MA). pp 241-246 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The house has 1,200 sq. ft. of flat plate collectors to heat 2,300 sq. ft. of living space. In the basement is a well-insulated 16,000-gallon storage pool. A heat exchanger for domestic hot water is placed near the top of the pool. Performance and cost savings figures are included. (MHR)

42724 Requirements for insulation in solar heated homes. Wolfe, J. pp 279-280 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

42725 (COO—4546-10) **Industrial process heat for sugar processing. Final report of Innovative Research Program Subtask, December 1977—September 1978.** Schierholz, P.M.; Downs, H.W. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 6p. Dep. NTIS, PC A02/MF A01.

A thorough review of the beet sugar process was made. Plant tours were conducted, and numerous meetings were held with officials from both the Beet Sugar Development Foundation and the industry. Although most sugar companies view their energy balance information as proprietary, arrangements were made with the Holly Sugar Company in Colorado Springs to obtain energy balances for use during the study. In addition, the Holly Sugar Company has been actively involved in the study of geothermal production and utilization of low to medium grade steam. Since solar systems are currently available for producing steam of this quality, study of the utilization scheme in the geothermal study helped define areas where steam produced with alternate sources such as solar energy might be used. These areas are discussed.

WATER HEATING

REFER ALSO TO CITATION(S) 42674, 42687, 42707, 42711, 42714, 42716, 42723

42726 (SOLAR/1010—78/14) **Solar energy system performance evaluation: February—September 1978. A-Frame Industries, single family dwelling, Kaneohe, Hawaii.** Nemetz, D.L. (International Business Machines Corp., Huntsville, AL (USA)). 1978. Contract EG-77-C-01-4049. 29p. Dep. NTIS, PC A03/MF A01.

This System Performance Evaluation report presents a summary of the February through September 1978 operation of the A-Frame Industries solar energy system. This system is designed to provide domestic hot water for a single family dwelling in Kaneohe, Hawaii. Presented are results of an evaluation of measured system performance and a comparison of measured climatic data with long term average conditions. Performance evaluations of each major subsystem are also presented.

42727 Solar installers: the evolution of a trade. Schwolsky, R. (Sunrise Solar Services, Newfane, VT). pp 303-307 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

A brief discussion of the previous installation activity in this country and a close look at the current installation trade are presented. The early solar water heaters in California and Florida are emphasized. (MHR)

42728 New England electric solar hot water heating experiment. Meeker, J. pp 487-492 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Experience with 100 installations in the New England Electric program is reviewed. The major problems identified and being addressed are reviewed. (MHR)

42729 Residential solar water heaters: recommendations for the protection of consumers, manufacturers, and installers. pp 493-511 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The types of systems in the New England Electric solar water heater experiment are reviewed. The trouble analysis and mechanical and economic aspects are summarized. Recommendations for the protection of consumers and recommended industrial practices are presented. (MHR)

42730 Solar inner-city apartment retrofit in a historically certified zone: a case study. Prowler, D. (Univ. Pennsylvania, Philadelphia). pp 161-164 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

An active solar domestic hot water system to provide approximately 75% of the hot water needs of the nine apartment units that comprise the building is described. The system consists of 14 collectors with an outer glazing of acrylic and an inner glazing of Teflon film. The absorber plate in the panel is comprised of copper piping and aluminum fins coated with a slightly selective flat black paint. The anti-freeze will be FDA approved UCAR Foodfreeze propylene glycol which is a non-toxic substance. A blue dye will be added for leak identification. (MHR)

42731 Design of a solar domestic hot water system for a college dormitory. Wright, W.A. (Worcester Polytechnic Inst., MA). pp 193-197 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The analyses leading to the selection of solar collectors for a solar water heating system are described. (MHR)

42732 Large-scale solar system for a high rise building in eastern Massachusetts. Strong, S.J.; Serdy, J.G. pp 198-199 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

42733 Performance history of first residential solar installation in Charlottesville, Virginia (open flow collector retrofit). Gottschalk, W.L. (The Rosemary, Orange, VA). pp 215-219 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The continuous monitoring of an indoor swimming pool retrofitted with a 450 ft^2 open flow solar collector over a period of 1 1/2 years reveals that at least 78% of the annual 48,260 (thermal) kWh pool heating load is delivered by solar energy. Average pool cool-off rates, clear day heat delivery and auxiliary gas heater burn times are used to measure annual heat delivery. The long term economic analysis of the project reveals a net return on investment of 300% over the 20-year analysis period.

OTHER

REFER ALSO TO CITATION(S) 43291

42734 (NTIS/PS—78/1288) **Solar water pumps (citations from the engineering index data base). Report for 1970-Nov. 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1978. 46p. NTIS PC N01/MF N01.

Design concepts and the technical and economic feasibility of using solar energy to pump water are discussed in abstracts from worldwide literature. Topic areas cover the use of solar heat actuated Rankine cycle engines and free cylinder Stirling engines for solar powered water pumps, pumps driven by photovoltaic modules, and application of solar pumps to irrigation and electric power generation. (This updated bibliography contains 40 abstracts, 9 of which are new entries to the previous edition.)

42735 (SAND—79-7009) **Modification and 1978 operation of the Gila-Bend solar-powered irrigation pumping system. Final report.** Alexander, G.; Busch, D.F.; Fischer, R.D.; Smith, W.A. (Battelle Columbus Labs., OH (USA)). Mar 1979. Contract EY-76-C-04-0789. 126p. Dep. NTIS, PC A07/MF A01.

The design modification, testing, and data acquisition and analysis of the 50 horsepower solar-powered irrigation pumping system are described. The system is composed of a field of solar-tracking parabolic reflectors, a Rankine-cycle turbine engine, and a conventional water pump. The system is used to return excess irrigation water from a collection sump to irrigation ditches servicing an area of approximately 5000 acres. It is designed to deliver a maximum of 10,000 gallons of water per minute. In addition to collector modifications, the system was converted for hybrid electric operation. Maintenance is described, and performance data are given. (WHK)

42736 Solar still. Grosse, A.V. (to A and T Development Corp.). US Patent 4,141,798. 27 Feb 1979. Filed date 30 Jan 1978. 8p.

A solar still includes a pair of parallel dikes separated by a ditch, a first sheet overlying the ditch and pair of parallel dikes, the sheet having a pair of edges arranged substantially parallel to, and outside, the dikes, and a second sheet overlying the first sheet, the second sheet having a pair of edges bonded together with the edges of the first sheet to form a water vapor-impervious seal. A plurality of vertical columnar supports are periodically positioned in spaced relation between the first and second sheets in the center of the ditch to maintain the second sheet in spaced relation above the first sheet. The second sheet has a ridge coincident with the supports and filamentary members which connect the tops of the supports, and

angularly slopes on either side thereof toward the outer edges of the dike. A plurality of spacers are positioned between the first and second sheets periodically along the top of each dike and extending slightly outward therefrom to maintain a spaced relationship between the first and second sheets at the outer edges of the pair of dikes. The joined first and second sheets form a trough on the outside of each dike. This solar still is paricularly useful in connection with greenhouse structures employed in desert agriculture as disclosed in US Pat. No. 4,040,216.

42737 Sorption system for low-grade (solar) heat utilization. Tchernev, D.I. US Patent 4,138,850. 13 Feb 1979. Filed date 2 Aug 1976. 10p.

A system is disclosed for the effective utilization of low-grade heat sources such as solar energy, with a system including a molecular sieve material such as zeolite and a gaseous fluid adapted to be absorbed by the material which is in a closed container and circuit which includes a condenser and a gas expansion cooler member. When the container is heated, a gas is given off from the molecular sieve material, cooled in a condenser, and thereafter expanded for cooling purposes. In one embodiment, the cooled gas is received in a further container having absorbent material and subsequently, upon cooling of the first container, the gaseous fluid may be returned thereto via again a condenser and gas expansion cooler member to provide futher cooling. In another embodiment, the molecular sieve material is formed by sintering same to form a pressure resistant divider across the container. One side of the divider is heated to create a temperature gradient across the divider so that it functions as a heat energized pump for the gaseous fluid which is absorbed, a pressure as well as temperature differential developing within the container across the divider whereupon the heated pressurized gas, after giving up some of its energy in a circuit which may include a condenser and gas expansion member, is returned to the container to be again pressurized and heated by the action of the divider composed of the molecular sieve material.

42738 Multi-stage-flash/fluidized bed evaporator in combination with solar energy as heating source. Klaren, D.G.; Pieper, G.A. (Esmil Res, Ijmuiden, Neth). pp 31-40 of Fresh Water from the sea. Delyannis, A.; Delyannis, E. (eds.). Frankfurt am Main, Germany; European Federation of Chemical Engineers (1978).

From 6. international symposium on fresh water from the sea; Las Palmas, Gran Canary, Spain (17 Sep 1978).

The multi-stage flash/fluidized bed evaporator is described which enables reliable operation at low temperatures and high gain-ratios; this, of course, perfectly suits the application in combination with solar energy. A 500 m^3/d multi-stage flash/fluidized bed evaporator in combination with solar energy is described and its production cost compared with a conventional flash evaporator heated by steam, generated from the combustion of fossil fuels.

42739 Use of double stage solar stills for nocturnal production. Malik, M.A.S.; Puri, V.M.; Aburshaid, H. (Kuwait Inst for Sci Res). pp 367-379 of Fresh Water from the sea. Delyannis, A.; Delyannis, E. (eds.). Frankfurt am Main, Germany; European Federation of Chemical Engineers (1978).

From 6. international symposium on fresh water from the sea; Las Palmas, Gran Canary, Spain (17 Sep 1978).

In the desalination of seawater by using solar energy, brine can be preheated to produce nocturnal distillate. In the present paper, the nocturnal output of a double stage solar still is digitally simulated. The digital simulation for nocturnal output considers--for both stages--a range of initial brine temperatures and associated brine depths. A broad range of climatological variables have been used in the study. The study also indicates how to use a given amount of waste heat (Q) for obtaining increased nocturnal distillate from the two stages in a solar still.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 42538, 42668, 42684, 42690, 42715, 42772

42740 (IS-M—207) Membrane stratified solar ponds. Hull, J.R. (Iowa State Univ. of Science and Technology, Ames (USA)). 1979. Contract W-7405-ENG-82. 5p. (CONF-790541—8). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The membrane stratified solar pond is a body of liquid utilizing closely spaced transparent membranes to quench convective heat transfer in the top part of the pond. Several suitable pond liquids and membrane materials are discussed. Conditions for suppression of convection are described for several membrane geometries, and radiation transmission is discussed for the horizontal sheet configuration. Thermal behavior is similar to that of salt gradient solar ponds, but much deeper heat storage layers are feasible. In some cases aquaculture farming may be suitable in the storage layer.

42741 (MLM—2616(OP)) Performance of a large, salt-gradient solar pond. Wittenberg, L.J.; Harris, M.J. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract AC04-76DP00053. 4p. (CONF-790803—2). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Initial performance data collected from the largest, salt-gradient solar pond in the U.S. indicate that it has the potential to be a very low-cost solar-heating system. The solar pond at Miamisburg, Ohio, occupies an area of 2000 m^2 and was installed for only \$35/m^2. The pond is predicted to deliver 281,000 kW.hr/yr to be used principally for heating an outdoor swimming pool in the summer and a recreation building during October—December. Based upon straight amortization of 10%/yr, this heat is predicted to cost 2.5 cents/kW.hr.

42742 (SAND—78-2423C) Recent developments regarding electrodeposited black chrome solar coatings. Pettit, R.B.; Sowell, R.R. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-790120—3). Dep. NTIS, PC A02/MF A01.

From 2. annual conference on absorber surfaces for solar receivers; Boulder, CO, USA (24 Jan 1979).

The thermal stability of electrodeposited black chrome solar coatings, obtained from Harshaw Chemical Co. Chromonyx bath, has been studied as a function of various plating parameters. The composition of the standard bath was determined to be chromic acid (332 g/1), acetic acid (226 g/1), trivalent chromium (16 g/1), iron (8 g/1) and barium (8 g/1). For coatings obtained from the standard bath, the solar absorptance decreased by ~ 8% when heated above 300°C in air. When the trivalent chromium concentration was reduced to values as low as 8 g/1, the solar absorptance of coatings remained unchanged after aging at 350°C in air for over 1800 hours. Of several other plating variables studied, only the current density and substrate appear to have an effect on the thermal stability. Auger sputter profiles of film composition after thermal aging indicate a higher metallic chromium content in the coatings plated from the low trivalent chromium bath as compared to coatings plated from the standard bath.

42743 (SAND—79-1116C) Midtemperature solar thermal systems design handbook: parabolic troughs. Harrigan, R.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790541—13). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

Ongoing efforts at Sandia Laboratories (SLA) to develop a Solar Thermal System's Design Handbook are outlined. The handbook deals, at this time, only with parabolic trough collector systems operating up to 315°C (600°F). While useful to anyone doing solar thermal design involving parabolic troughs, the handbook application is primarily aimed at commercial Architectural and Engineering firms. Publication of the handbook is anticipated for the Fall 1979. Updating of the handbook is expected to occur continuously as the rapidly developing solar technology matures.

42744 (SAND—79-7005) Determination of the technical and economic feasibility of luminescent solar concentrators. Final report. Rapp, C.F.; Boling, N.L.; Thomas, I.M.; Opdycke, G.L.; Fechter, R.B.; Chrysochoos, J.; Friedman, P.S. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 213p. Dep. NTIS, PC A10/MF A01.

A photovoltaic concentrator of novel design has recently been suggested. In its simplest form, this concentrator is a large thin flat plate of some luminescent material with photocells attached at its edges. Sunlight incident on the face of the plate is absorbed and reemitted as luminescence. A large fraction of this luminescence is trapped inside the plate by total internal reflection until it reaches an edge where it is coupled into a photocell. This study was primarily concerned with a somewhat different concentrator configuration that offers several distinct advantages. In this configuration, a thin luminescent film (≈ 1 mil) is deposited on an undoped substrate (≈ 1/8" thick). The luminescence then originates in the film but is trapped within the entire thicker structure. In this study, a large number of fluorescent dopant-host combinations were identified. These were primarily organic but inorganic materials were also included. Absorption spectra, emission spectra and quantum efficiencies were measured on various samples in order to identify the best candidates for the luminescent concentrator device. Six inch by six inch and twelve inch by twelve inch concentrator plates were made which demonstrated approximately 15% effective concentrator efficiencies. The major loss mechanisms responsible for decreases in collector efficiencies were identified and quantitatively evaluated. Efficiency improvement factors of several times appear possible.

42745 (SERI/TP—35-208) **Solar pond concepts: old and new.** Jayadev, T.S.; Edesess, M.; Henderson, J. (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 7p. (CONF-790803—3). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Different types of solar ponds have been considered from the early 1900s to the present. Salty ponds use salt to create a nonconvecting pond. Shallow solar ponds were investigated by Shuman and Willsie in 1906 and 1907 and are currently being studied by Lawrence Livermore Laboratories. Swedish investigators are studying a combination of solar collectors and water storage in a pond-cover configuration. In addition, there are thermoclines created in large bodies of water, as in large reservoirs. This paper surveys the various types of solar ponds, classifies and models them, and then tries to combine the best of the ideas to synthesize new concepts. It presents a new solar pond concept which combines the good features of convecting and nonconvecting (salty) ponds.

42746 (SERI/TP—35-213) **Economic and performance comparisons of salty and saltless solar ponds.** Edesess, M.; Benson, D.; Henderson, J.; Jayadev, T.S. (Solar Energy Research Inst., Golden, CO (USA)). 1979. Contract EG-77-C-01-4042. 9p. (CONF-790803—20). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

The optimum solar pond design is site-dependent and application-dependent. Foremost of the design decisions is the choice of a salty (nonconvecting) pond or a saltless (convecting) pond. The decision variables are: local availability and cost of salt, type of salt available and its properties, and possible environmental factors such as the effects of salt run-off and the existence of ground water. The availability of salt is an important factor in determining the economics of salty ponds. For example, sodium sulfate is a potentially low-cost substitute for sodium chloride, and is expected to be in plentiful and widely distributed supply in the near future as a waste product of flue gas desulfurization at coal-fired utility plants. This paper discusses the potential supply of such salts and estimates the breakpoint in net cost of salt at which a convecting pond becomes economically competitive with the salty pond.

42747 (TID—28787) **Materials for solar thermal conversion. Quarterly report No. 1, September 1—December 31, 1977.** Gittleman, T.I. (RCA Labs., Princeton, NJ (USA)). Jan 1978. Contract EG-77-C-02-4557. 16p. Dep. NTIS, PC A02/MF A01.

Specimens of Ge—CaF_2 and Si—CaF_2 composites have been prepared for: (1) the determination of the optical constants; (2) the characterization of the composite semiconductors; and (3) reflectance measurements (when specimens were deposited on mirror substrates). While the results of Auger, ESCA and TEM analyses are not yet available, a picture of the composite semiconductors is beginning to emerge based on the wavelength dependence of the optical constants. As noted in the previous section $\alpha = A(h\nu - E_0)^2$ where A increases as f/sub v/ increases and E_0 is independent of f/sub v/. Thus, the semiconductor composites behave like semiconductors with an energy gap equal to that of the semiconductor component and with a reduced index of refraction. The above property is just the one needed for efficient selective absorption. This is demonstrated by the reflectance of the composite films on mirrors. The reflectance measurements also reveal unexpected absorption bands which may be due to chemical reaction between the semiconductors and the insulator. When the source of this absorption is determined, methods of eliminating it will be explored.

42748 (Y/DA—8090) **Electroforming a mold for casting plastic fresnel lenses.** Waldrop, F.B.; Waldrop, R.C.; Washington, C.A.; Patterson, H.F. (Oak Ridge Y-12 Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

The problems involved in diamond turning an aluminium mandrel and electroforming a negative off this mandrel from which lenses can be cast are described. Surface cleaning, parting the electroform from the mandrel, surface properties, and method modifications are discussed. (MHR)

42749 **Horizontally mounted solar collector.** Black, D.H. (to National Aeronautics and Space Administration). US Patent 4,148,295. 10 Apr 1979. Filed date 9 Aug 1977. 6p.

A horizontally mounted solar collector for collecting solar energy utilizing a vertical deflector assembly, a stationary reflector and a collector. The deflector assembly contains a plurality of vanes which change the direction of the solar energy to the vertical, while constantly keeping the same side of the deflector facing the sun. The vertical rays are then reflected off the stationary reflector and are then absorbed by the collector.

42750 **Solar energy collector having a convection current inhibiting member.** Hopper, T.P. (to Sunworks, Inc.). US Patent 4,147,156. 3 Apr 1979. Filed date 23 Mar 1977. 6p.

A solar energy collector housing is disclosed having a transparent cover, and a solar energy absorbing panel in the housing beneath the cover, and including a transparent member having closed tubular air pockets positioned between the panel and the cover to inhibit convection currents therebetween.

42751 **Device for collecting solar energy.** Krafft, F.G. US Patent 4,147,155. 3 Apr 1979. Filed date 19 Jan 1977. 6p.

A device for collecting solar heat energy in which a transparent glass or plastic member, preferably extruded, is provided with the body having upper and lower and peripheral walls with integral passages extending therethrough parallel and spaced from the top and bottom walls and through which fluid is passed. On opposite sides of the passages, dead gas spaces are formed in the body of the glass or plastic material for insulating purposes. The collector according to the present invention can be mounted in a frame and tilted by an automatic device so as always to present the device in a plane substantially normal to the direction of solar radiation.

42752 **Solar collector cover.** Keith, E.W. US Patent 4,141,185. 27 Feb 1979. Filed date 18 May 1977. 6p.

An improved solar collector cover for reducing energy loss in flat plate solar collectors is disclosed. The cover provides a solar radiation transmitting material containing a plurality of sealed evacuated passageways or cavities.

42753 **Solar heat absorber.** Lof, G.O.G. US Patent 4,141,338. 27 Feb 1979. Filed date 18 Aug 1975. 6p.

A relatively thin solar heat collector is disclosed, for solar heat collecting units, having a series of discontinuities in its surface in the form of projections, increasing surface area for absorption and heat transfer.

42754 **Solar energy collector.** Niedermeyer, W.P. US Patent 4,141,340. 27 Feb 1979. Filed date 8 Jun 1977. 8p.

Apparatus for and method of collecting, concentrating, and transmitting solar energy is disclosed including: one or more reflector surfaces for directing the solar rays to a focus area, absorption means disposed in said focus area, a heat transfer medium external to the focus area, and a heat conduit operatively interconnecting said absorption means, and said transfer medium.

42755 **Solar heat collector.** Weinstein, A. (to Westinghouse Electric Corp.). US Patent 4,141,339. 27 Feb 1979. Filed date 15 Jul 1977. 6p.

A relatively low cost and lightweight solar energy collector is disclosed of the type in which air is used as the heat transfer medium is provided by a frame member having the general form of an upwardly open box formed of relatively low density rigid thermal insulating slabs, a solar insulation absorber plate within the box, and a transparent glazing cover for closing the top open side of the box, with the edges of the frame member being secured to and sealed with the glazing cover by a high temperature adhesive and sealant which has the property of flexibility in maintaining its sealing and bonding character throughout the variations in temperature to which the solar collector is subjected to thereby accommodate the differential expansion of the box relative to the cover. The box has a width which permits it to nest between the framing members of the structure to which it is to be applied, and the cover has a slightly greater width so that it is supported by the exterior faces of the framing member and accordingly is integrated into the building structure to provide an exterior surface of the building in the area of the collector.

42756 **Solar heating panel.** Eby, A.T. US Patent 4,141,341. 27 Feb 1979. Filed date 4 Apr 1977. 4p.

A solar heating panel includes a unitary rectangular shell having a low thermal conductivity urethane foam liner sandwiched between inner and outer fiberglass boxes. The inner box is impregnated with a dark coloring and has spaced raised support and expansion ridges extending traversely across its bottom. An integral lip located at the top of the shell stiffens its sidewalls and mounts a thermally insulated window comprised of paired sheets of glass separated by a sealed space. A thermal collector assembly adapted for placement within the shell on the support and expansion ridges is comprised of a serpentine heat transfer coil and an adjacent planar collector sheet which are integrally formed by joinder of a plurality of stamped unitary modular units dimensioned to be received within the collector shell. An inlet and an outlet pass from opposite ends of the heat transfer coil out of the shell through openings in its sidewalls.

42757 **Fibrous wall material for cell structures of solar energy collectors.** Hussmann, E. (to JENAer Glaswerk Schott and Gen.). US Patent 4,138,990. 13 Feb 1979. Filed date 18 Mar 1977. 8p.

Fibrous wall materials that are substantially transparent to solar radiation and substantially imprevious to long-wave radiation wherein the fibers are arranged in a parallel relationship are disclosed as being useful to form cell structures, in the form of a

honeycomb. Heat losses from such solar enegy collectors are substantially minimized.

42758 Techniques for reducing thermal conduction and natural convection heat losses in annular receiver geometries. Ratzel, A.C.; Hickox, C.E.; Gartling, D.K. (Fluid Mechanics and Heat Transfer Division, Sandia Laboratories, Albuquerque, N. M. 87185). *J. Heat Transfer;* **101**: No. 1, 108-119(Feb 1979).

Analytical and experimental work has been undertaken to analyze thermal conduction and natural convection heat losses in annular receiver geometries. Techniques studied for reducing conduction heat loss include evacuation of the annulus gas, oversizing of the annular space while maintaining slight vacuum levels, and use of gases other than air in the annular space. For the geometry considered, total heat loss reductions of 10 percent to 50 percent may be obtained depending on the means by which the conduction heat loss is limited. In addition, natural convection studies considering the effects of nonuniform temperature distributions and eccentric cylinders are discussed. The numerical analysis performed indicates that highly nonuniform temperature distributions are required to appreciably affect the natural convection process between concentric cylinders and that rather large eccentricities cause only a slight increase in natural convection heat transfer.

42759 Natural convection heat transfer characteristics of flat plate enclosures. Randall, K.R.; Mitchell, J.W.; El-Wakil, M.M. (Mechanical and Nuclear Engineering Departments, University of Wisconsin, Madison, Wisconsin.). *J. Heat Transfer;* **101**: No. 1, 120-125(Feb 1979).

Heat transfer by natural convection in rectangular enclosures has been experimentally studied using interferometric techniques. The effects of Grashof number, tilt angle, and aspect ratio on both the local and average heat transfer coefficients have been determined. The Grashof number range tested was 4×10^3 to 3.1×10^5, and the aspect ratio (ratio of enclosure length to plate spacing) varied between 9 and 36. The angles of tilt of the enclosure with respect to the horizontal were 45, 60, 75 and 90 deg. Correlations are developed for both local and average Nusselt number over the range of test variables. The effect of tilt angle is found to reduce the average heat transfer by about 18 percent from the value of 45 deg to that at 90 deg. No significant effect of aspect ratio over the range tested was found. A method for characterizing the flow regimes that is based on heat transfer mechanisms is proposed.

42760 Solar heating collector apparatus. Davis, T.L. US Patent 4,136,670. 30 Jan 1979. Filed date 13 Jun 1977. 4p.

A solar heating system is disclosed including an energy absorbent collector dish for receiving solar heat, a supply tube for distributing a heat transfer fluid over the collector dish, a drain pipe for removing the heat transfer liquid from the collector dish and an optical director including an array of converging lenses oriented to receive radiant energy from the sun and to direct the energy onto the collector dish. The array of converging lenses comprises a matrix of double convex lenses that form one half of a hemispherical optical dome, the other half of which possesses an inner reflective surface for reflecting radiant energy onto the collector dish and the optical dome is oriented such that some portion of the lens array faces the sun during an entire day's movement.

42761 Multimode solar energy collector and process. Escher, W.J.D. US Patent 4,136,673. 30 Jan 1979. Filed date 11 Jul 1977. 10p.

A solar energy collector is disclosed providing both concentrating-tracking functions and non-concentrating diffuse absorption functions in a single unit. The solar energy collector and process may provide both a higher temperature heat transfer fluid and a lower temperature heat transfer fluid for utilization in various processes, such as air conditioning, which may advantageously utilize thermal energy of two different temperatures. The solar energy thermal collector and process of this invention provides a high temperature thermal output in combination with a simplified tracking capability.

42762 Solar concentrator with restricted exit angles. Rabl, A.; Winston R. (to Dept. of Energy). US Patent 4,130,107. 19 Dec 1978. Filed date 10 Nov 1977. 10p.

PAT APPL 850,340.

A device is provided for the collection and concentration of radiant energy and includes at least one reflective side wall. The wall directs incident radiation energy to the exit aperture thereof or onto the surface of energy absorber positioned at the exit aperture so that the angule of incidence of radiant energy at the exit aperture or on the surface of the energy absorber is restricted to desired values.

42763 Heating and ventilation system. Saunders, N.B. US Patent 4,129,120. 12 Dec 1978. Filed date 5 Aug 1977. 8p.

A heating system is disclosed which comprises a container having at least one heat absorbent surface, and at least one heat transmissive surface disposed so as to transmit solar heat to the internal surface. The container includes inlet means for introducing heat absorbing fluid into the container on one side of the heat absorbent surface and means disposed on the opposite side of the heat absorbent surface for withdrawing the heat absorbing fluid from the tank. The container is designed so that the fluid flow rate of the heat absorbing fluid toward the absorbent surface can be regulated so that the flow rate of heat from the heat absorbent surface remains substantially constant so as to establish a predetermined temperature gradient in the flowing fluid passing through the container.

42764 Autonomic solar panel. Savage, F.S.; Long, A.D. US Patent 4,106,482. 15 Aug 1978. Priority date 17 Apr 1976, Canada, 12p.

An autonomic solar heat collecting system is provided. The heart of the system is a solar panel including a flat outer surface adapted to be exposed to the direction of the radiation of the sun. A flat or formed inner sheet is provided which is closely spaced from the outer surface section. Preferably, a flat, transparent plate is provided, which is spaced from, which covers, and is disposed outwardly from, the flat outer section, thereby forming an air-tight compartment between itself and the flat outer surface. Joining the inner and outer surfaces to one another at the top and at the bottom provides a hollow, fluid-tight cavity. Because the inner and outer surfaces are closely spaced from each other, the fluid is in the form of a tin fluid membrane. Means are provided for allowing entrance of a fluid into the cavity and means are provided for removal of the fluid from the other cavity. To provide most efficient control and heat removal, the collector should be made of two copper sheets, the outer of which is flat, separated about 0.016 inches apart with an enclosed volume of fluid not exceeding about 2.3 cu.in./square foot of panel. Due to the small volume of fluid circulating through the solar panel, low power requirements are inherent to the system, and low voltage power is ample to activate the solar energy collecting system independent of any outside power source. Thus, an essential feature of the autonomic system is low wattage, low power pump means activated by a small predetermined temperature differential, and the means for providing power for the operation of the system is solar cells or wet or dry batteries.

42765 Design and material options for solar collector absorbers. Foster, W.M. (Alcoa Co., Pittsburgh, PA). pp 327-335 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The following are discussed: design specifications for solar products, swimming pool collectors, choice of absorber material for an unglazed collector, a bi-metallic absorber, and an all aluminium absorber. (MHR)

42766 Sunpak/sup TM/ evacuated tube collector: field experiences and developments. Mather, G.R. Jr. (Owens—Illinois, Inc., Toledo, OH). pp 355-357 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The efficiency and low loss coefficient of evacuated tube collectors in a cold cloudy climate are described. The collectors' durability and resistance to extreme weather conditions are emphasized. (MHR)

42767 New heat transfer factors for flat plate solar collectors. Lunde, P.J. (Center for the Environment and Man, Inc., Hartford, CT). pp 115-119 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

New expressions for the heat transfer factor F/sub R/ based on inlet, outlet, and mean fluid temperature are derived for use with the Hottel—Whillier collector model by the use of restrictive heat transfer assumptions. The new factors are simple algebraic functions which are shown to be equivalent to the generally accepted exponential relationships mathematically and in practice over the ordinary range of the variables involved.

42768 Air cooled collectors: applications and systems. Loope, R. (Enthone, Inc., West Haven, CT). pp 151-160 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Applications of solar air heating are reviewed such as direct space heating, crop drying and horticultural heating, industrial process heat, and wood and lumber drying. Work showing that the underpass air cooled collector is superior in thermal performance is

reviewed and it is concluded that a high systems performance may be further assured by attention to the various modes of operation, control of mass flow, and design of the storage container. (MHR)

HEAT STORAGE

REFER ALSO TO CITATION(S) 42708, 42745

42769 (ALO—5319-2) **Optimal insulation of pipes and tanks for solar heating systems. Topical report.** Jones, G.F.; Lior, N. (Pennsylvania Univ., Philadelphia (USA). Dept. of Mechanical Engineering and Applied Mechanics). Feb 1979. Contract EM-78-C-04-5319. 75p. Dep. NTIS, PC A04/MF A01.

A compact and time effective insulation design procedure for solar heating system piping and water-filled thermal storage tanks was developed. Recognizing the particular sensitivity of solar systems to cost, the economic aspect of the problem is treated by a comprehensive present-value life-cycle cost analysis. In the development of the method, a numerical sensitivity analysis was performed to determine the relative effects of all relevant independent variables (within their pertinent ranges) on piping and tank heat transfer coefficient values.

42770 (BNL—25909) **State of the art of sensible heat storage for solar source heat pump systems.** Metz, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790328—4). Dep. NTIS, PC A02/MF A01.

From Solar energy storage options workshop; San Antonio, TX, USA (18 Mar 1979).

Factors which influence the storage characteristics of solar source heat pump systems are discussed including: solar collection devices, the heat pump, and the utility interface. Some of the characteristics of solar source heat pumps storage are specified such as: temperature range and thermal inertia. The storage options which are discussed are: rock beds, water tanks, ground coupled storage, swimming pools, and ponds. (MHK)

42771 (COO—4479-2) **Experimental and numerical studies of liquid storage tank thermal stratification for a solar energy system. Semi-annual progress report, March 1—August 31, 1978.** Wu, S.T. (Alabama Univ., Huntsville (USA). Dept. of Mechanical Engineering). 29 Sep 1978. Contract EG-77-S-02-4479. 24p. Dep. NTIS, PC A02/MF A01.

The construction of the thermal stratification system was completed during the early part of 1978, and was checked out in April. The details of this check-out procedure ae included. The physical dimensions of the facility are shown. This storage tank is a modified septic tank with a capacity of 1500 gallons. This tank is installed with approximately half of the tank below ground. Insulation is 3" of spray-on foam externally and 1" internally, protected by a butyl rubber covering. The liquid level in the tank is 44". 6 figures, 4 tables.

42772 (COO—4546-9) **Solar generation of industrial steam. Final report of Innovative Research Program Subtask, December 1977—September 1978.** Lenz, T. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 10p. Dep. NTIS, PC A02/MF A01.

The objective of this study was to identify promising schemes for the collection and storage of solar energy for subsequent generation of moderate pressure industrial steam (200°C to 250°C) (392°F to 482°F). The thrust of the present study was therefore toward those lower temperature schemes which would allow potentially better economics than high temperature schemes plus substantial energy storage. Comparison of hybrid solar-mechanical (vaporization at low pressure followed by compression), inorganic salt eutectic and polymer latent heat slurry, and solar-thermochemical schemes, pointed to the thermochemical approach as most promising. The scope of interest was limited to condensed-phase reactions. The following classes of reactions meet the set of criteria: reversibly-catalyzed thermal isomerizations, Diels—Alder additions, and esterifications. These particular reaction clases offer significant potential for lower temperature solar-thermochemical systems with condensed phase energy storage.

42773 **Phase change thermal energy storage.** Popinchalk, P.B. pp 375-380 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Because of the time dependent nature of solar insolation and end use for space heating, efficient means of storing thermal energy is needed. Advantages of the use of latent heat storage are enumerated and potential problems associated with phase change materials are reviewed. Work in development and application is examined to determine feasibility. Finally, evaluation is presented of commercially available eutectic salt system as manufactured by Solar, Inc. of Mead, Nebraska.

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 42794, 42809

USA

42774 (CONF-790530—1) **Overview of geothermal energy in the United States.** Schultz, R.J.; DiBello, E.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1 May 1979. Contract EY-76-C-07-1570. 14p. Dep. NTIS, MF A01.

From Energy conservation symposium; San Francisco, CA, USA (1 May 1979).

Portions of document are illegible.

The history of geothermal development is reviewed briefly. The resource is divided into three major categories for discussion: hydrothermal resources, hot igneous rock resources, and conduction-dominated resources. Geothermal power generation and direct applications in the U.S. are discussed. (MHR)

42775 (NMEI—10) **Regional operation research program for development of geothermal energy in the southwest United States. Final technical report, June 1977—August 1978.** Marlin, J.M; Christ, R.; McDevitt, P.; Nowotny, K.; O'Dea, P.; Rao, C.R.; Swanberg, C. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Jan 1979. 315p. New Mexico State Univ., Las Cruces, NM.

This report describes the work accomplished from June 1977 to August 1978. The efforts by the Core and State Teams in data acquisition, electric and non-electric economic studies, development of computer support functions and operations, and preparation of geothermal development scenarios are described.

42776 (ORO—5442-1) **Operations research and systems analysis of geopressured/geothermal resources in Louisiana. Final report for initiation project.** Wilkins, B. Jr. (Louisiana State Univ., Baton Rouge (USA). Office of Advanced Studies and Research). Feb 1978. Contract EG-77-S-05-5442. 182p. Dep. NTIS, PC A09/MF A01.

The development activities for a plan for Louisiana's participation in a Gulf Coast regional research and systems analysis activity. In developing preliminary planning scenarios heavy emphasis was placed on data describing the resource base. The scenarios are produced using a computer-oriented planning program that is codenamed GEODEV. Examples of development scenarios for four fairways in Louisiana are included in an appendix. Progress in identification of decision makers, a state-wide advisory group, coordination of activities with Texas, and regional operations research activity. Also included in appendices are: communications to identify Decision Makers, Report to Governor and Legislature on Status of GP/GT Energy in Louisiana, and a paper presented jointly by Louisiana and Texas Project Team at Third Geopressured Geothermal Energy Conference, University of Southwestern Louisiana, Lafayette, Louisiana. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

42777 **Geothermal energy resources of the western United States.** Boulder, CO; National Geophysical and Solar-Terrestrial Data Center (1977). vp.

This map shows hydrothermal convection systems with assumed reservoir temperatures, low-temperature thermal springs, heat flow locations and values, KGRA's, prospective KGRA's, earthquake epicenters, major faults, and volcanoes and volcanic regions. (MHR)

NON-USA

REFER ALSO TO CITATION(S) 42786

42778 **Report of exploratory geothermal basic investigation for Hanamaki No. 4.** Tokyo, Japan; Ministry of International Trade and Industry (1978). 77p. (In Japanese). (NP—23711). Geological Literature Center, Tokyo, Japan.

A geological survey was conducted in the area from Hanamaki to Ishitoridami-cho in Iwate prefecture in late 1976 and early 1977. Four separate studies are presented: an alteration zone survey, a hot springs geochemical survey, a discharged heat survey, and a gravity survey.

42779 Report of alternation zone survey. Tamao, S.; Kanehara, K. pp 1-32 of Report of exploratory geothermal basic investigation for Hanamaki No. 4. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

The Tsukasemori, Katumarugawa, and Dai-Shitodaria areas located between Hanamaki and Ishitoridani-cho in Iwate Prefecture were surveyed from September 1976 to January 1977. An aerial photographic survey, field survey, and x-ray analysis were conducted. In the Tsukasemori area, weak alteration zones were observed but no geothermal indicators were found. In a small depressed area attributed to the Quaternary Katsumaru volcano, a sulfur deposit was observed. In the Katsumara area, there were four alteration zones subjected to either argillization or silicification, which developed in the Neogene system. These are considered to be due to the hydrothermal alteration of the Neogene system attributable to the post-volcanic action of intrusive rhyolite. Again, there were many ot springs where a weakly argillizated alteration zone (a-zone) and a silicificated alteration zone (b-zone) were observed. The a-zone is distributed along the radial rhyolite dike where the Dai hot springs are found, and the b-zone is found in the intrusive rhyolite portion but is not related to hot springs. The a-zone contained particularly promising geothermal indicators especially at great depths.

42780 Report of exploratory geothermal investigation for Garandake—Kurokawa. Tokyo, Japan; Ministry of International Trade and Industry (1978). 132p. (In Japanese). (NP—23709). Geological Literature Center, Tokyo, Japan.

A geological survey is presented of Garandake—Kurokawa volcanic area. Reports include an alteration zone survey, a survey of the geochemical content of hot springs, a discharged heat survey, and a gravity survey.

42781 Report of alteration zone survey. Kanehara, K.; Sudo, S. pp 1-39 of Report of exploratory geothermal investigation for Garandake—Kurokawa. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

The eastern Garandake area is composed of Sanin volcanic rock (primarily hornblende-andesitic tuff breccia), and has an alteration zone of more than 3.2 x km^2 extending to the east and west. The alteration zone is divided into two sections: the Moyban hot springs-centered zone and the Tsukahara mining-centered zone. These silicificated zones are surrounded by weak alteration zones, an alumitized zone, kaolinitic silicificated zone, montmorillonite, and zeolite. In the western part of the Garandake area, there is the Kajika—Kanarugoe volcanic rock and the Oita group which are subjected to weak alteration action which has formed zeolite and alpha-crystobalite. This alteration zone is only 0.04 km^2. In the Kurokawa area, there is the Suzume Jigoku (0.14 km^2), a zone upstream of the Kurokawa hot springs (0.05 km^2), the Kurokawa hot springs (0.11 km^2) a zone along te Yoshi River (0.57 km^2), and a zone in and around Tawara (0.11 km^2), totaling 0.96 km^2. The most strongly altered zones are the Kurokawa hot springs area and the zone located along the Yoshigawa River, where alum and kaolinite are formed. In the Kurokawa hot springs, high temperature (98°C at the highest) hot water is produced.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 42778

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 42779, 42780, 42781

42782 Preliminary report on heat flow in the central part of Kagoshima Bay, Kyushu, Japan. Matsubayashi, O.; Kinoshita, H.; Matsubara, Y.; Matsuda, J. *Chishitsu Chosasho Geppo;* **30**: No. 1, 45-49(Jan 1979). (In Japanese).

Heat flow measurement was carried out under shallow seas in the central part of Kagoshima Bay by using a submersible thermopile heat flux transducer. Heat flow values higher than 1,200 mWm^{-2} along the structural depression with NNW-SSE trend in the center of the bay were obtained. The results indicate the presence of a large heat source and fractures for hydrothermal circulation in the igneous rocks which underlie the thick sediments of the bottom of the central part of Kagoshima Bay.

42783 Report of discharge of heat. Takagi, S. pp 57-65 of Report of exploratory geothermal basic investigation for Hanamaki No. 4. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

Total heat discharge from hot springs, exhalations, and by thermal conduction was determined from October through November 1976 in the Yuguchi area (about 15.7 km^2 including Shitodaira, Osawa, and Namari hot springs along the River Toyosawa northwest of Hanamaki) and the Dai area (about 27 km^2 including Dai hot springs about 1 km west of Hanamaki hot springs). The following formula was used to determine the discharge heat of 19 fountainheads in Yuguchi and 33 in Dai: $Q_1 = (Tx - T^0)\ Vx$, where T_0 is annual atmospheric temperature, Q_1 is heat quantity, and Tx and Vx are the temperature and flow rate of hot water at the fountainhead, respectively. Total discharged heat was 2283 kcal/sec. Soil temperature at 1 m depth indicated that areas with temperatures above 12°C were distributed in a belt running through Shidodaira, Osawa, and Namari hot springs in and around the Toyasawa River. Greater than 13°C temperature areas were found near Osawa and Namari hot springs in the Yuguchi area. In the Dai area, the area with greater than 12°C temperatures surrounded the Dai hot springs, extending to the northeast. The survey of heat discharged by thermal conduction in the Yuguchi area found a high heat flow area of more than 20 x 10^{-6} cal/sec cm^2 along the road from Namari hot springs to the Shimoshizawa as well as in the Osawa hot springs. A high heat flow area of more than 20 x 10^{-6} cal/sec cm^2 was found in the Dai area about 0.7 km north of the Dai hot springs. The average heat flow calculated was 15.6 x 10^{-6} cal/sec cm^2 for Yuguchi and 22.4 x 10^{-6} cal/sec cm^2 for Dai.

42784 Report of gravity survey. Suda, Y.; Kenzo, O. pp 67-85 of Report of exploratory geothermal basic investigation for Hanamaki No. 4. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

A gravity survey was conducted in a 720 km^2 area surrounding Hanamaki in Iwate Prefecture, where there are many hot springs and other geothermal indicators. A N—S gravity anomaly was determined in the Kitagami mountains coinciding with the Morioka—Shirakawa tectonic line, and in the Hairyo mountains. Granites in this area in general show a high gravity anomaly but not in all of the exposed granite areas. The high gravity anomaly area in the western end of the Kitagami mountains is exposed basement rock. The Hairyo mountains also show a high gravity anomaly, leading to the estimation of two N—S basement upheaval areas. The area surrounding the Dai hot springs which are located south of this area has a large basin-like structure down to depths of 2500 to 3000 m. Also in this area are intrusive rocks. The hot springs are located in the periphery of the low gravity anomaly area, and also in and around the Dai hot springs intrusive rocks where a slight high gravity anomaly was observed. In the Hanamaki area, the low gravity anomaly in and around the intrusive rocks may be an important geothermal field. This area should be investigated further.

42785 Report of discharged heat quantity survey. Yuhara, K. (Kyushu Univ., Japan). pp 101-118 of Report of exploratory geothermal investigation for Garandake—Kurokawa. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

The 1 m and 20 m depth soil-temperature survey indicated that the geothermal sources in the Garandake area are limited to a shallow area on the western slope of Garandake. The discharged heat by heat conduction in the subject area was 98 kcal/sec/1.7 km^2, and the discharged heat in the exhalative areas totaled 632 kcal/sec. The discharged heat in the hot springs of Garandake, where 8 fountainheads are producing hot water with temperatures of 24.5 to 78.0°C, was 280 kcal/sec. Thus, the total discharged heat in the Garandake area was 1.0 x 10^6 cal/sec of which more than 90% is produced by exhalations and hot springs.

42786 Report of gravity survey. Ogawa, K. pp 119-132 of Report of exploratory geothermal basic investigation for Garandake—Kurokawa. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

The 310 km^2 area surveyed included Beppu, Yufuin, Anshinin, and Hinode-cho. Most of the hot springs are distributed between the Matsuyama—Imari tectonic line and the Asamigawa fault and extend into the Yufuin area. The hot springs in the Beppu and Garandake areas are distributed along tectonic lines estimated from gravity surveys and along confirmed faults such as the Asamigawa fault. They are abundant where an east—west fault and a north—south fault intersect as in the Tsurumi and Shibaishi areas. The hot springs in the Yufuin area are found in the Yufuin basin which showed a low gravity anomaly, especially where many comparatively equigravity lines are observed north of the fault and west of the center of the low gravity anomaly. Promising geothermal fields in this area are the Beppu and Garandake areas including the Tsurumi and Shibaishi areas.

GEOCHEMICAL TECHNIQUES AND SURVEYS

42787 (LA—7757-MS) **Wet geothermal potential of the Kingman-Williams region, Arizona.** Goff, F.E. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

The Kingman-Williams region, Arizona, possesses few thermal waters of deep origin. Evaluation of 33 waters (8 thermal) reveals that thermal waters are restricted to the Basin and Range tectonic province; no thermal waters were found on the west margin of the Colorado Plateau. The thermal waters appear to rise along north-trending normal faults or flow in deep aquifers in Quaternary sedimentary basins of the Basin and Range province. All thermal waters have distinctive chemistry and discharge at temperatures ranging from 28 to 46°C. They apparently issue from small isolated geothermal reservoirs. Geothermometry and chemmistry indicate that these are low-temperature reservoirs that probably do not exceed 115°C.

42788 **Field measurements of volcanic gases.** Le Guern, F. (CFR-CNRS, Gif-sur-Yvette, France); Bicocchi, P.; Nohl, A.; Tazieff, H. *C. R. Hebd. Seances Acad. Sci., Ser. D;* **288**: No. 10, 867-870(12 Mar 1979). (In French).

A field gas chromatograph built in 1978 was used for field gas analysis before water sample cooling and condensation. Tested in Vulcano (Italy), Kilauea (Hawaii) and Merapi (Indonesia) this technique provides the actual composition of the volcanic gas mixture. The mixture of H_2S and SO_2 in fumarolic and high temperature magnetic gases (up to 819°C) was observed.

42789 **Chemical composition, hydrogen and oxygen isotope ratios, and tritium content of hot waters and steam condensates from the Oyasu-Doroyu-Akinomiya geothermal area in Akita prefecture, Japan.** Abe, K.; Shigeno, H.; Ikeda, K.; Ando, N.; Goto, J. *Chishitsu Chosasho Geppo;* **30**: No. 3, 177-197(Mar 1979). (In Japanese).

The major and minor chemical components, hydrogen and oxygen isotope ratios, and tritium content of river, cold spring, and hot spring waters, as well as fumarolic condensates from the Oyasu-Doroyu-Akinomiya geothermal area were analyzed. The hot waters, steam condensates blown off from explorative wells and hot waters collected from different depths of the bore in the Oyasu area were also analyzed. The hot springs and fumaroles erupt mostly from Neogene and are distributed predominatingly in the NE-SW direction regionally but in the NW-SE direction locally. The estimated underground temperatures from silic content and Na—K—Ca ratios of hot waters never correspond to each other in the case of the acidic Cl^- and the acidic SO_4^{2-} types, but in the case of the neutral $Na^+.Cl^-$ type from the Oyasu area, they attain maximum about 200°C and agree well with the bottom temperatures of the wells. The acidic Cl^- and SO_4^{2-} types of hot spring waters show distinct oxygen shift accompanied with hydrogen shift, but the neutral $Na^+.Cl^-$ type of hot spring waters and hot waters from the geothermal wells hardly show the oxygen shift compared with the river and cold spring waters. The tritium content of hot waters is relatively high in the case of the acidic Cl^- and SO_4^{2-} types, but in the case of the neutral $Na^+.Cl^-$ type it does not exceed 1 T.U. and the origin of the water is supposed to be meteoric water precipitated probably more than thirty years ago.

42790 **Report of geochemical survey.** Hirukawa, T. pp 33-55 of Report of exploratory geothermal basic investigation for Hanamaki No. 4. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

Data on the chemical composition of hot springs are presented. Collection of data by a literature search and from government organizations, and the computer method used to process the data, are reviewed. Thirty-one fountainheads were tested from hot springs including Namari, Takakurayama, Yamanokami, Osawa, Shitodaira, Matsukura, Dai, Hanamaki, and New Hanamaki. Data are presented on temperature, pH, and the following chemical components: K, H, Na, NH_4, Ca, Mg, Fe, Mn, Zn, Cu, Pb, Al, Cl, Br, K, F, OH, SO_4, S_2O_3, HCO_3, SiO_2, H_3PO_4, H_2SO_4, CO_2, H_2S, Rn, and As.

42791 **Report of geochemical survey.** Hirukawa, T. pp 41-99 of Report of exploratory geothermal investigation for Garandake—Kurokawa. Tokyo, Japan; Ministry of International Trade and Industry (1978). (In Japanese)

Existing geochemical data on the geochemistry of hot springs in the Garandake—Kurokawa area were compiled from public and private public health organizations, colleges, and universities. Collection of the data and computer methods used are described. The hot springs considered are Tsukahara, Ufuin, Okue, Kurokawa, Yudaria, Manganji, and Beppu, and 107 fountainheads are included. Water quality is described in terms of temperature, pH, and the following chemical components: H, K, Na, NH_4, Ca, Mg, Fe, Mn, Zn, Cu, Pb, Al, Cl, Br, I, F, OH, SO_4, S_2O_3, HCO_3, CO_3, SiO_2, HBO_2, H_3PO_4, $HAsO_2$, CO_2, H_2S, Rn, and others. Charts of water composition and frequency charts are provided.

EXPLORATORY DRILLING AND WELL LOGGING

42792 (COO—4972-1) **Microcrack technology. Progress report, 1 October 1978—31 March 1979.** Simmons, G.; Batzle, M.L.; Shirey, S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Earth and Planetary Sciences). Apr 1979. Contract ER-78-S-02-4972. 40p. Dep. NTIS, PC A03/MF A01.

The microcracks were observed in core samples from Coso and Raft River Geothermal Areas. A set of observable characteristics of microcracks were discovered in racks from geothermal regions that appears to be unique and to have considerable potential for exploration for geothermal regions. Both permeability and electrical conductivity were measured for a suite of samples with a range of microcracks characteristics. A partial set of samples were collected to study migration of radioactive elements. (MHR)

42793 (LBL—8538) **Recent activities at the Cerro Prieto field.** Alonso E, H.; Dominguez A, B.; Lippmann, M.J.; Manon M., A.; Schroeder, R.C.; Witherspoon, P.A. (Comision Federal de Electricidad, Mexico City; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

Some of the latest activities of interest to reservoir engineers at the Cerro Prieto geothermal field are described. Special emphasis is given to the wells drilled in 1978 for exploration purposes and to provide steam to the existing and future power plants. The present power output is 75 MW. Two additional 37.5 MW units are scheduled to go on line in March and May 1979, while the total generating capacity at Cerro Prieto will reach about 400 MW in 1985.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 42775

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 42775

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 43245, 43246

42794 (CONF-790445—3) **Environmental implications for geothermal energy development.** Craig, R.B.; Suter, G.W. II. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From 19. annual meeting of the institute of environmental sciences; Seattle, WA, USA (29 Apr 1979).

The nature of geothermal resources and the constraints that site characteristics place on their development are discussed. (MHR)

42795 (PB—287817) **Ecological implications of geopressured-geothermal energy development Texas-Louisiana Gulf Coast region.** Gustavson, T.C.; McGraw, M.M.; Tandy, M.; Parker, F.; Wohlschlag, D.E. (Texas Univ., Austin (USA). Bureau of Economic Geology). Aug 1977. Contract DI-14-16-0008-2141. 670p. NTIS PC A99/MF A01.

This report reviews the ramifications of commercial development of thermal-hydraulic energy for the generation of electrical power. It includes an extensive review of information regarding fish and wildlife, and the estimated impact from geothermal developments; a review of geothermal energy conversion systems, contrasting them with alternate systems; and a listing of unique or endangered species within the region.

42796 (UCID—18155-79-1) **Geothermal environmental control technology. Progress report, December 1978—March 1979.** Phelps, P.; Hill, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 141p. Dep. NTIS, PC A07/MF A01.

The following items are included: outline for report on ECT (Environmental Control Technology) workshop for The Geysers - Calistoga KGRA; outline for report on ECT for the Imperial Valley; a list of documents reviewed; an update on the Geothermal Loan Guaranty Program; trip reports; an update on LLL work to reabsorb H_2S in spent brine done at Niland; meeting summaries; field task proposal; a summary of a joint cooling tower effects study; and a fiscal and manpower statement. (MHR)

42797 (UCRL—13995) **Overview of environmental issues: Roosevelt Hot Springs KGRA, Utah geothermal noise effects.** Leitner, P.

(Saint Mary's Coll. of California, Moraga (USA)). 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

It is important to evaluate the potential for environmental noise problems prior to large-scale geothermal development at Roosevelt Hot Springs and other KGRAs in southwestern Utah. This will be accomplished by considering the types of geothermal noise sources to be expected, existing ambient noise conditions within the region, locations of noise receptors, and any applicable regulations or standards. The final step in the analysis is a definition of key issues relating to noise and an outline of a research program which will help to ensure that geothermal development can proceed without creating unacceptable noise impacts.

42798 (UCRL—52683) **Northern California Power Association-Shell Oil Company Geothermal Project No. 2: noise effects.** Lamson, K.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

Occupational and environmental noise impacts are evaluated from the construction and operation of the Northern California Power Association-Shell Oil Company 110-MW geothermal power plant and associated steam wells located in The Geysers-Calistoga Known Geothermal Resource Area. Available data and measurements indicate that the nearby populated noise-sensitive areas will not be significantly affected by the construction or operation of this facility.

42799 **Durability of timber silencers at Wairakei geothermal steam field.** Hedley, M.E. (Forest Research Inst., Rotorua, New Zealand). *N.Z. Eng.;* **34**: No. 2, 26-29(Feb 1979).

After early failures of reinforced concrete silencers and because of high costs of concrete-lined steel structures, preliminary tests were undertaken to assess the suitability of timber for silencer construction. Tests indicated that radiata pine treated with pentachlorophenol/oil or untreated red beech had most potential for timber silencer fabrication. One prototype silencer of each material was constructed and both were installed on operational bores in 1965. The red beech silencer had a service life of 4 years. The radiata pine silencer operated for 12½ years, although replacement had been recommended 1 year before this time expired. The performance of this silencer encouraged the general use of timber for silencer construction and further units were built. Procurement of satisfactory grades of timber has proved difficult and has limited silencer fabrication. Ways of improving timber supply, which require modification of silencer design, are discussed.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 42793, 42809

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 43536

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

42800 (BM-RI—8350) **Corrosion studies in brines of the Salton Sea Geothermal Field.** Carter, J.P.; McCawley, F.X.; Cramer, S.D.; Needham, P.B. Jr. (Bureau of Mines, Avondale, MD (USA). Avondale Metallurgy Research Center; Bureau of Mines, Washington, DC (USA)). 1979. 35p. U.S. Dept. of the Interior, Bureau of Mines, Washington, DC.

Toward the goal of maximizing minerals and metals recovery from domestic resources, the Bureau of Mines, U.S. Department of the Interior, has conducted in situ corrosion studies at the Salton Sea Known Geothermal Resources Area (KGRA) in the Imperial Valley, Calif., to evaluate and characterize materials of construction for geothermal resources recovery plants. General-, pitting, and crevice-corrosion characteristics of 13 commercially available alloys were investigated for periods of 15 and 30 days in seven process environments expected to be found in typical geothermal resources plants. Stainless steel alloy 29-4, Inconel 625, and the Hastelloys G, S, and C-276 were the most resistant to general corrosion, did not pit, and exhibited little susceptibility to crevice corrosion. Stainless steel alloys 430, E-Brite 26-1, and 6X had low general corrosion rates, but pitted and were susceptible to crevice corrosion. Stainless steel alloy 316 L had a low corrosion rate, but corroded intergranularly, pitted, and was susceptible to crevice corrosion and to stress-corrosion cracking. Titanium—1.5 nickel and TiCode-12 had low corrosion rates, did not pit, and were not susceptible to crevice corrosion. Carbon and 4130 steels had high corrosion rates, pitted, and had high susceptibilities to crevice corrosion. The major scale-forming mineral on the corrosion samples in most of the process environments studied was galena mixed with lesser amounts of other minerals.

42801 (IDO—10083) **Completion report: Raft River Geothermal Injection Well Six (RRGI-6).** Miller, L.G.; Prestwich, S.M. (Idaho National Engineering Lab., Idaho Falls (USA); Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Feb 1979. Contract EY-76-C-07-1570. 29p. Dep. NTIS, PC A03/MF A01.

Raft River Geothermal Injection Well Six (RRGI-6) is an intermediate-depth injection well designed to accept injection water in the 600 to 1000 m (2000 to 3500 ft) depth range. It has one barefoot leg, and it was drilled so that additional legs can be added later; if there are problems with intermediate-depth injection, one or more additional legs could be directionally drilled from the current well bore. Included are the reports of daily drilling records of drill bits, casings, and loggings, and descriptions of cementing, coring, and containment.

42802 (IDO—10084) **Completion report: Raft River Geothermal Injection Well Seven (RRGI-7).** Miller, L.G.; Prestwich, S.M. (Idaho National Engineering Lab., Idaho Falls (USA); Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Feb 1979. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

Raft River Geothermal Injection Well Seven (RRGI-7) is an intermediate-depth injection well designed to accept injected water in the 600 to 1000 m (2000 to 3500 ft) depth range. It has one barefoot leg, and it was drilled so that additional legs could be added later; if there are problems with intermediate-depth injection, one or more additional legs could be directionally drilled from the current well bore. This report describes the drilling and completion of RRGI-7 and provides a brief summary of preliminary testing. It includes daily drilling reports, as well as records of logging, coring, and containment techniques used during drilling operations.

42803 (TID—28685) **Semi-annual report on the project to design and experimentally test an improved geothermal drill bit, phase II.** Barker, L.M.; Green, S.J. (Terra Tek, Inc., Salt Lake City, UT (USA)). Dec 1976. Contract EY-76-C-07-1546. 50p. Dep. NTIS, PC A03/MF A01.

The test facilities (the geothermal drilling vessel and the geothermal drill-bit seal tester) were completed and de-bugged, and the first tests were run on full-scale research drill bits and drill-bit seals. In addition, more materials information was gathered, and a number of additional seals of high-temperature elastomer materials were obtained for testing. Maurer Engineering, on a subcontract basis, has also been active in the design and procurement of candidate high-temperature drill-bit seals for testing, and has done a literature and patent search on the problem of drill-bit insert retention. Reed Tool Co. has cooperated in the fabrication of drill bits for testing, and has offered consultation on certain seal designs.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

42804 (CONF-790219—6) **Corrosion of copper—zinc and copper—nickel alloys in a geothermal brine.** Miller, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 46p. Dep. NTIS, PC A03/MF A01.

From AIME annual meeting; New Orleans, LA, USA (18 Feb 1979).

The rationale for using materials selection rather than chemical inhibition for corrosion control is discussed. The geothermal environment used for the tests is described. General corrosion caused the majority of the weight loss in the copper and the copper—zinc alloys. Localized corrosion was the principal mode of attack in the copper—nickel alloys. Our tests show trends towards higher corrosion rates with increasing copper content for both copper—zinc and copper—nickel alloys. The copper—nickel alloys have corrosion rates about six times those of brasses of similar copper content. Commercially pure copper has a corrosion rate 20 to 30% of the rate suggested by trends in the data for the brasses. Sulfides appear to be the major aggressive species for the materials studied. Sulfide corrosion products retained on the surfaces of the samples usually provided some protection to the substrate metal.

42805 (UCID—18195) **On-line tests of organic additives for the inhibition of the precipitation of silica from hypersaline geothermal brine II. Tests of nitrogen-containing compounds, silanes, and additional ethoxylated compounds.** Harrar, J.E.; Locke, F.E.; Otto, C.H. Jr.; Lorensen, L.E.; Frey, W.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Jun 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

Several new classes of organic compounds have been screened as potential geothermal scale control agents by examining their effect on the precipitation of silica from Magmamax No. 1 brine. The substances were tested using the Lawrence Livermore Laboratory Brine Treatment Test System at the Niland, California, Test Site. Solutions of the test substances were injected into flowing

brine at 210°C, the brine was flashed to 125°C, and then the kinetics of solids and silica precipitation from effluent brine held at 90°C were measured. Three new types of compounds were shown to have activity as precipitation inhibitors: polyethylene imines, polyethyloxazalines, and quaternary ammonium compounds containing polyoxyethylene. Among the latter, Ethoquad 18/25, which is methylpolyoxyethylene(15) octadecylammonium chloride, is the leading candidate antiscalant. It is a more powerful inhibitor of silica precipitation than the pure polyoxyethylene polymers, and it apparently has no high temperature solubility limitations. Measurements were made of the concentrations of monomeric silica and the effect of addition of inhibitor at various points in the Brine Treatment Test System. Five different silane compounds showed no activity toward silica.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

42806 **Effect of vapor-pressure lowering upon pressure drawdown and buildup in geothermal steam wells.** Moench, A.F.; Herkelrath, W.N. (Geological Survey, Menlo Park, CA). pp 465-468 of Geothermal energy: a novelty becomes resource. Transactions. Volume 2, Section 2. Davis, CA; Geothermal Resources Council (1978).

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

The equilibrium vapor pressure of liquid water in an unsaturated porous medium is less than the steam-table value. This phenomenon is incorporated into a finite-difference model for the production of steam in vapor-dominated geothermal reservoirs. In the model the steam is assumed to be produced by boiling of immobile liquid water in the vapor-dominated zone. Assuming radial symmetry, plots of pressure buildup and drawdown are obtained both with and without vapor-pressure-lowering. The results show that whereas pressure drawdown is virtually unchanged, the pressure buildup curve is significantly different when the vapor-pressure lowering effect is included. The pressure plateau predicted by the model without vapor-pressure lowering is eliminated, and the response is similar to that expected for noncondensable gas.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

42807 (IDO—1608-T1) **Studies of geothermal reservoir stimulation by hydraulic fracturing.** Abou-Sayed A.S.; Buchholdt, L.M.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Dec 1977. Contract EG-76-C-07-1608. 82p. Dep. NTIS, PC A05/MF A01.

Hydraulic fracturing treatment to stimulate hot water or steam geothermal well flow provides great economic incentive opportunities by raising the production to an acceptable economic level. To data, however, no geothermal well has been fractured, except for the Los Alamos Scientific Laboratory hot dry rock well. This is mainly due to the great risk of damaging the well and losing all production from that well and maybe even nearby wells and/or incurring very high costs during a fracturing treatment. As part of the effort to reduce the risks involved in stimulation treatment of geothermal wells, the current program was started with the idea of studying various aspects of geothermal reservoir stimulation by hydraulic fracturing. The work done in the following areas is summarized: assessment of the state of technology, site characterization studies aimed at identifying the site most suitable for hydraulic fracturing experiments, evaluation of the physical and mechanical properties of the selected reservoir rock and determination of factors affecting induced fracture conductivity, and analytical studies of downward hydraulic fracture stimulation of hot dry rock geothermal reservoirs.

DIRECT ENERGY UTILIZATION

42808 (CONF-790446—1) **Heat pumps coupled to geothermal resources can provide economical process heat.** Neill, D.T.; Schmitt, R.C. (Idaho State Univ., Pocatello (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From 4. annual heat pump technology conference; Stillwater, OK, USA (9 Apr 1979).

Temperatures available from geothermal resources are frequently too low to serve the needs of many process industries. Heat pumps can be used to boost the temperatures by moderate amounts at an economical cost. A number of potential working fluids were examined for service from 150°F to 400°F. Steam and R-11 were found to be the best choices. Comparison cost estimates were made for different bottom temperatures and delivery temperatures for both steam and R-11 systems. The results show that electricity to drive the compressor, capital investment in the compressor and in the geothermal resource all make significant contributions to the cost of process heat delivered by the heat pump.

42809 (LBL—8918) **Geothermal energy for industrial application.** Fulton, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 19p. (CONF-790358—1). Dep. NTIS, PC A02/MF A01.

From Association of energy engineers conference; San Francisco, CA, USA (21 Mar 1979).

The types of geothermal resources are reviewed briefly. The uses of geothermal energy are covered under electrical generation and non-electric direct uses. (MHR)

GEOTHERMAL DATA AND THEORY

PROPERTIES OF AQUEOUS SOLUTIONS

42810 (LBL—8973) **Thermodynamics of high temperature brines.** Pitzer, K.S.; Bradley, D.J.; Rogers, P.S.Z.; Peiper, J.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 40p. (CONF-790415—32). Dep. NTIS, PC A03/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

Osmotic and activity coefficient data and enthalpy and heat capacity data for NaCl solutions at saturation pressure of water from 0 to 300°C and to saturation composition have been simultaneously fit to a 30 parameter equation. The data are reproduced by the equation, in most cases, to within experimental error. Calculated values of the osmotic coefficient, the activity of water, the activity of NaCl, and the heat capacity, enthalpy and entropy of the solution are given in Tables in 25°C intervals from 0 to 300°C and concentrations from 0.25 to 25 wt% NaCl.

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 42792

ISOTOPE AND TRACE ELEMENT STUDIES

42811 **Biotite--apatite geothermometer revisited.** Ludington, S. (Geological Survey, Denver, CO). *Am. Mineral.;* **63**: No. 5-6, 551-553(May 1978).

The proposed biotite—apatite geothermometer of Stormer and Carmichael (1971) is refined by taking the effect of octahedral cation substitution in biotite into account and by incorporating some new thermochemical data for the phases involved. For the reaction, biotite(F) + apatite(OH) reversible biotite(OH) + apatite(F), it is proposed that T(Kelvins) = 1100/log K*, where log K* = log [X/sub F//X/sub OH/]/sub ap/ + log [X/sub OH//X/sub F/]/sub bio/ - 1.107(X/sub annite/) - 1.444(X/sub siderophyllite/). These revisions lead to higher calculated temperatures.

TIDAL POWER

REFER ALSO TO CITATION(S) 42534, 42655

WIND ENERGY

REFER ALSO TO CITATION(S) 42534, 42535, 42537

42812 (DOE/ET—0093) **Wind energy systems: program summary.** (Department of Energy, Washington, DC (USA). Office of Solar, Geothermal, Electric and Storage Systems). Dec 1978. 134p. Dep. NTIS, PC A07/MF A01.

The objective of the Federal Wind Energy Program is to accelerate the development of reliable and economically viable wind energy systems and enable the earliest possible commercialization of wind power. This summary report outlines the projects funded by the program during FY 1978 toward the achievement of these goals. It also outlines the program's general organization and specific program elements. Many projects initiated in previous years continued through FY 1978. Earlier issues of this Program Summary should be consulted for complete details about these projects.

42813 **Federal Wind Energy Program.** Tennyson, G.P. (Dept. of Energy, Washington, DC). pp 483-484 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 42822

42814 (NP—23761) **Scientific investigations of tropical wind, energy conversion and reference level experiment (TWERLE). Final technical report, July 1976—September 1977.** Suomi, V.E.; Massman, W.; Hinton, B.; Afanasjevs, J. (Wisconsin Univ., Madison (USA). Space Science and Engineering Center). Jan 1978. 42p. NTIS, PC A04/MF A01.

The results from the Tropical Winds, Energy Conversion and Reference Level Experiment (TWERLE) for the period July 1976 through 6 September 1977 are summarized. These results are: a latitude profile of the rate of conversion from kinetic to potential energy for the period from 12 June 1975 to 1 August 1976; evidence that gravity waves generated in the troposphere systematically deposit energy in the vicinity of the tropopause, and are a mechanism for the dissipation of kinetic energy on the global scale; and evidence that the jet stream is an important mechanism for generating these waves.

42815 (PNL—2538) **Assessment of the applicability of the national fire weather data library to wind energy analyses. Final report.** Marlatt, W.E.; Tierney, P.; Meilke, P.; Baer, M.; Childs, J. (Marlatt and Associates, Fort Collins, CO (USA)). May 1979. Contract EY-76-C-06-1830. 115p. Dep. NTIS, PC A06/MF A01.

The specific scope of work for this effort followed this sequence: review of the Fire Weather Library for stations with usable records; development of statistical summaries for selected individual stations; screen summaries for common windy areas; develop statistical comparisons of fire weather stations with nonfire weather stations having multiple observations per day; develop frequency spectra of wind periods above threshold values; and estimate seasonal and geographic distributions of wind energy. Following discussions with the PNL, efforts for objective four, the comparison of one observation per day to multiple observations for the same station, were deferred until the results from a similar study at Northwestern University were available.

42816 (UCRL—52789) **Comparison of the finite element and finite difference methods in a diagnostic regional wind field model.** Rodriguez, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 97p. Dep. NTIS, PC A05/MF A01.

Thesis.

A comparative study was undertaken to investigate the similarities and differences between the finite element and finite difference methods of numerically approximating an objective analysis equation. Both models are three-dimensional, time-independent, and incorporate terrain in adjusting a field of observed three-component velocities to achieve mass-consistency. Principles from the calculus of variations are utilized in developing model equatons. The variational approach assumes that velocities input to the models are a fair representation of actual mean winds. Starting with meteorological data available randomly on a regional scale, wind component values are interpolated and extrapolated to each grid point in the calculational domain in a manner consistent with prevailing meteorology. Model adjustments are made in response to the original mass-inconsistency in this field of discrete velocities and to the topographical boundary surface representing the application area.

ECONOMICS

42817 **Promise and problems in applying new technology in large-scale wind energy conversion systems.** Moses, R. (Kaman Aerospace Corp., Bloomfield, CT). pp 361-364 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The feasibility of large wind power plants connected to electric utility power systems is analyzed. Technical and economical aspects are considered.

42818 **Economics of wind energy conversion systems for electrical power generation.** Johanson, E.E. (JBF Scientific Corp., Wilmington, MA). pp 437-444 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The Energy Resarch and Development Administration (ERDA) has funded eight studies on the economics of wind energy conversion systems (WECS). These eight studies have been reviewed, the results put on a common economic basis, and are presented here in 1975 dollars. A copy of the full report, prepared under contract to ERDA, will be available from NTIS in the fall of 1977.

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 43237

APPLICATIONS

42819 (PB—287593) **Wind and solar energy applications study.** Koide, G.T.; Takahashi, P.K. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). Aug 1977. 113p. NTIS PC A06/MF A01.

The study on solar radiation and wind power applications is a facet of the total solar assessment program. Engineering consultants, government authorities, technology assessment specialists and businessmen were contacted for input into the report. The result is a broad implementation plan highlighting seven typical applications--three solar, three wind and one combination.

42820 **Wind furnace project.** Cromack, D.E. (Univ. of Massachusetts, Amherst). pp 427-432 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

One of the most cost effective applications for wind power is thought to be for space heating. A brief description is presented for the UMass Wind Furnace. The design and construction aspects along with a discussion of the preliminary component tests and initial operational experience are included. The Wind Furnace will be demonstrated under fully atuomatic operation during the 1977-1978 heating season.

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 43161

42821 (DOE/NASA/1004—79/1) **Utility operational experience on the NASA/DOE MOD-0A 200-kW wind turbine.** Glasgow, J.C.; Robbins, W.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EX-76-A-29-1004. 32p. (NASA-TM—79084; CONF-790213—6). Dep. NTIS, PC A03/MF A01.

From 6. energy technology conference and exposition; Washington, DC, USA (26 Feb 1979).

The Mod-0A 200 kW Wind Turbine was designed and fabricated by the Lewis Research Center of the NASA under the direction of the Department of Energy. The project is a part of the Federal Wind Energy Program and is designed to obtain early wind turbine operation and performance data while gaining initial experience in the operation of large, horizontal axis wind turbines in typical utility environments. On March 6, 1978 the Mod-0A wind turbine was turned over to the Town of Clayton Light and Water Plant, Clayton, NM, for utility operation and on December 31, 1978, the machine had completed ten months of utility operation. The machine is described. The recent operational experience at Clayton, NM is summarized.

42822 (INKA-CONF—78-012-001) **Seminar and status report on wind energy.** Buschulte, W. (Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.)). 1978. 23p. (In German). (CONF-7810148—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Seminar and status report on wind energy; Julich, F.R. Germany (23 Oct 1978).

The meteorological requirements for the operation of wind energy systems are described and descriptions of small and larger plants, part of them in the planning stage and part of them already in operation, are presented.

42823 **Performance of the optimal wind turbine.** Griffiths, R.T.; Woollard, M.G. (Univ Coll, Swansea, Wales). *Appl. Energy;* 4: No. 4, 261-272(Oct 1978).

The performance of a typical wind turbine, designed to give maximum power coefficient at a tip speed ratio of 5, has been estimated over a range of speed ratios and pitch angles using blade element theory. Information is given on the power, torque, and thrust developed and on the nature of the flow over the blades.

42824 **Proceedings of the national conference: American Wind Energy Association.** Nelson, V. (ed.). Canyon, TX; West Texas State Univ. (1978). 187p. (CONF-780357—). $9.00.

From National conference of the American Wind Energy Association; Amarillo, TX, USA (1 Mar 1978).

Separate abstracts are included for papers presented concerning the development of wind turbines and wind power plants.

42825 Small wind systems program development. Carlin, P. pp 413-425 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The DOE-sponsored small wind turbine testing program at the Rocky Flats Plant is described.

42826 Cycloturbine and its potential. Drees, H.M. (Pinson Energy Corp., Marstons Mills, MA). pp 433-436 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Pinson Energy Corporation, a privately funded company, was formed to develop and produce the Cycloturbine, a wind energy converter. Pinson Energy has its offices in Marstons Mills, Massachusetts, and a test facility at New Seabury, Massachusetts, both on windy Cape Cod. Testing of a prototype Cycloturbine was initiated early in 1976. The test program yielded valuable data utilized in the design of an improved second prototype. Testing of this second machine is nearing completion and presently four preproduction units are being installed as part of Pinson Energy Corporation's field test and demonstration program. It is anticipated that production-run Cycloturbines will be available on a limited and selective basis in mid 1978.

42827 Feature review of some advanced and innovative design concepts in wind energy conversion systems. Weisbrich, A.L. (Kaman Aerospace Corp., Bloomfield, CT). pp 445-458 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

In response to the impending energy situation, numerous alternative energy generation schemes are being proposed and pursued. Specifically, in the area of wind energy much effort is being expended to develop a superior energy conversion system. Some advanced wind energy conversion system (WECS) concepts are presented and their features highlighted. Although others may be pursuing similar or other concepts, only certain individuals and organizations associated with these concepts are specified.

POWER CONVERSION SYSTEMS

42828 Some effects of wind energy conversion systems on electric distribution system. Goodrich, R.W. pp 367-370 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

An overview is presented of how each type of wind energy conversion system electric generator affects the safety and quality of service of electric utilities.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 43240

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 42151, 42533

42829 (FE—1726-17A) Engineer, design, construct, test and evaluate a Pressurized Fluidized Bed Pilot Plant using high sulfur coal for production of electric power. Phase I. Preliminary engineering. Annual report, March 1, 1976—February 28, 1977. (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). 15 Mar 1977. Contract EX-76-C-01-1726. 151p. (CW-WR—76-015.20A). Dep. NTIS, PC A08/MF A01.

Work performed from March 1, 1976 to February 28, 1977 to Engineer and Design a Pressurized, Fluidized Bed Pilot Plant using high sulfur coal for production of electric power is summarized. A conceptual design of a 500 MW commercial power plant is described. Plant efficiencies of 40% are projected. The preliminary performance and design arrangement of the PFB Pilot Plant are presented, with comparisons tabulated between the latter and the commercial plant. Also described are supporting technological test programs and results, covering heat exchanger performance and corrosion/erosion resistance of candidate materials for heat exchanger and turbine application. Design was completed and construction begun for the Small Gas Turbine/Pressurized Fluidized Bed (SGT/PFB) operating parameters rig which fully simulates the pilot plant operating environment. Fabrication of heat exchanger tubes, and SGT/PFB components is described.

42830 (KFK-PDV—160) System development for optimizing electric power supply equipment. ??Dobberstein, J.; Petroianu, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Sep 1978. 121p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

The ever increasing demand for efficient and reliable supply and distribution of electric power necessitates continual improvement of the overall system. Since electric power cannot be stored it is indispensable for the electric utilities to provide a continuous supply of electricity. Meeting momentary overloads involves additional expenses on the part of the electric utilities, e.g., by the startingup of peak-load power stations. An economical solution is offered by the control of loads connected to a power supply network. A system using a process computer and a ripple control system has been developed which permits establishing a closed circuit through the power distribution network and controlling selected loads in accordance with prediction procedures. The distribution network is operated on-line in a closed loop. A special PID control algorithm has been developed for load control.

POWER CYCLES

REFER ALSO TO CITATION(S) 42836

42831 (DOE/NASA/2593—79/6) Gas-turbine Critical Research and Advanced Technology Support Project: FY 1978 annual report. Clark, J.S.; Lowell, C.E.; Niedzwiecki, R.W.; Nainiger, J.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1979. Contract EF-77-A-01-2593. 40p. (NASA-TM—79139). Dep. NTIS, PC A03/MF A01.

The technical progress made during the first 15 months of a planned 40-month project to provide a critical-technology data base for utility gas-turbine systems capable of burning coal-derived fuels is reported. Coal-derived fuels present two major problems to utility gas turbines. First, they are typically high in organically bound nitrogen, which is converted in the combustion process to oxides of nitrogen (NO/sub x/). Second, they contain trace-metal contaminants that can lead to hot corrosion in the turbine hot sections. A combustion task is under way to address the first problem. A literature survey of coal-derived-fuel properties was completed and an NO/sub x/ emission model was developed. Test rigs have been designed and are being built to experimentally study the conversion of fuel-bound nitrogen to NO/sub x/. To address the second problem, a statistically designed series of hot-corrosion burner rig tests were conducted to measure the corrosion rates of typical gas-turbine alloys with several fuel contaminants. The resultant data have been correlated into a hot-corrosion-life prediction model. Another approach to solving the hot-corrosion problem is to use a fuel additive that inhibits hot corrosion. Barium has been identified as a particularly beneficial fuel additive. Still another approach to preventing hot corrosion is to protect the hot components with a coating. Ceramic thermal-barrier coatings offer potential corrosion resistance as well as thermal protection. Several advanced thermal-barrier coatings have demonstrated promising hot-corrosion resistance.Systems studies were also conducted to help integrate and guide the technological efforts. An analytical study of thermal-barrier coatings used in conjunction with water- and steam-cooled turbine airfoils indicated substantial performance improvement over that of an uncoated system. Specific power also increased, which should lead to lower capital costs.

42832 (MIT—2295T18-10) Combined cycle research program. Quarterly technical progress report No. 10, 1 October—31 December 1978. Louis, J.F.; Sotak, A.E. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jan 1979. Contract EX-76-C-01-2295. 67p. Dep. NTIS, PC A04/MF A01.

Gas turbine-steam turbine combined cycle power plants, operating on coal or coal-derived fuels, are thought by many experts to be the most practical and efficient choice for next generation electric power production. The major benefits of this combined cycle system are the potential attainment, at relatively low risk and development cost, of high efficiencies while maintaining pollutant emissions within environmental specifications. The industrial gas turbine is not without its development problems, however. Research is needed in turbine cooling, turbine materials corrosion, and fuel gas clean-up. While separate disciplines in themselves, they all closely interrelate in determining allowable turbine operating temperature and overall cycle performance. This three-year research program deals with critical problems related to combined cycles: turbine cooling with

air and water, materials corrosion, and high-temperature fuel gas desulfurization. Research in these areas will provide data needed for turbine component design and thus serve as a necessary complement to the DOE High-Temperature Turbine Technology Program. The effort will also provide corrosion data for other metal and ceramic components and necessary information concerning high-temperature desulfurization, as well as providing accurate experimental data for input into, and verification of, the various computer simulator models under development.

42833 Stirling cycle engine. St. Clair, J.C. US Patent 4,055,960. 1 Nov 1977. Filed date 6 Jul 1976. 1p.

The hot and cold gases of a Stirling Cycle engine are stored in the opposite ends of a rotating hollow cylinder with the inner surface of the cylinder covered with water held in place by centrifugal force. The hot and cold gases are kept separate by a piston, that moves back and forth in the rotating cylinder, with the outer edge of the piston dipping in the ring of water providing a gas seal. The gas when heated and introduced into the hot end of the rotating cylinder is given the same angular velocity as the rotating hollow cylinder by means of a large number of small holes in a molybdenum sheet of metal. The molybdenum metal is strong and is not corroded, in the hydrogen gas used as the working fluid, at temperatures as hot as 2200° Fahrenheit or even hotter. The system is the basis of a low first cost power plant where hydrogen is compressed, expanded through a turbine with the generation of power and then compressed over again. The overall power plant needs less than 7500 BTU per KWH. With the use of solar heat stored in enormous piles of sand-lime pebbles with cooling water sprayed in winter and stored in holes, from which has been obtained sand which is made into sand-lime mortar for the pebbles, heat rates of as low as 6500 BTU per KWH can be obtained.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 43209, 43315

42834 EPA's waste-to-energy research program. Freeman, H.M. (Environmental Protection Agency, Cincinnati, OH). pp 477-480 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

COMPONENTS

REFER ALSO TO CITATION(S) 43209, 43401

42835 Use of digital computers for designing the optimal operation of a multi-stage boiler of a heat and electric power plant. Vinogradnik, M.V. *Prom. Energ.;* No. 8, 44-46(Aug 1978). (In Russian).

A method is proposed for compiling an algorithm for solving the problem of the optimal heating distribution in a heat and electric power plant boiler in stages, and an example of its application is given. The problem's solution is tied to the problem of optimal load distribution among the turbo-aggregates. Substantiation is offered for the partial criterion of optimal operation - a minimum of weighted average pressure of bleed steam (with respect to heat) on the released heat.

42836 (FE—1806-T1) **Development of high temperature turbine subsystem technology to a technology readiness status, Phase I and Phase II. Abstracted technical annual report.** Day, W.; Caruvana, A.; Rose, R. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 1978. Contract EX-76-C-01-1806. 6p. Dep. NTIS, PC A02/MF A01.

A summary is presented of progress in the High-Temperature Turbine Technology (HTTT) Program. The objective of the HTTT Program is to bring to technology readiness a high-temperature turbine for use in a combined cycle utilizing coal-derived fuel at a firing temperature of 2600°F with growth capability to 3000°F while significantly increasing the overall plant efficiency. This program was divided into three phases: program and system definition (Phase I); technology testing and test support studies (Phase II); and technology readiness verification test program (Phase III). Phase I has been completed. A water-cooled gas turbine was selected as the Prime Reference Design to operate at a 2600°F firing temperature. A preliminary design was completed including aerodynamics, heat transfer, mechanical design, materials, and manufacturing considerations. Three preliminary combustor designs were completed. They included a sectoral, an annular, and a cylindrical combustor with a water-cooled transition piece. The sectoral combustor was selected because it incorporates advanced aircraft engine combustor technology with circular combustor maintainability. The water-cooled turbine, operating in a combined cycle with an integrated fixed-bed gasification system was shown to have an overall plant (coal pile-to-busbar) efficiency of 41.4%. The design of the Technology Readiness Vehicle (TRV) is proceeding in support of the component designs which will be tested in Phase II. The Hot Gas Path Development Test Stand design has been finalized, drawings issued, and fabrication has started. (LCL)

42837 (HCP/T1237—01/13) **Multicell fluidized bed boiler design construction and test program. Quarterly progress status report, July—September 1978.** (Pope, Evans and Robbins, Inc., New York (USA)). May 1979. Contract EX-76-C-01-1237. 100p. Dep. NTIS, PC A05/MF A01.

The objective of this program is to design, construct and test a multicell fluidized-bed boiler as a pollution-free method of burning high-sulfur or highly corrosive coals without excessive maintenance problems. The fluidized-bed boiler will provide approximately 300,000 lb/h of steam. Steam pressure and temperature conditions were selected to meet requirements of the site at which the boiler was installed.

42838 Double reheat hydrogen/oxygen combustion turbine system. Somers, E.V. (to Westinghouse Electric Corp.). US Patent 4,148,185. 10 Apr 1979. Filed date 15 Aug 1977. 4p.

The invention discloses a gas turbine power generating system comprising, in the preferred embodiment, three gas turbine engines in series-connected flow communication employing high pressure hydrogen and oxygen as the fuel. Pre-heated pressurized steam (or a steam and water mixture) is fed to the initial gas turbine combustor for combustion coolant. Steam, consisting of the products of combustion plus the vaporized coolant, is exhausted from the first turbine into the combustor of the next turbine for re-heating via the combustion therein of the high pressure hydrogen and oxygen. The exhaust steam from the intermediate turbine is in turn re-heated in the combustor of the final turbine. The final exhaust steam is then passed through a recuperative heat exchanger to preheat the pressurized cooling water so that, when injected into the first combustor, it is vaporized prior to entering the first turbine.

42839 Method for regulating the power output of a thermodynamic system operating on a closed gas cycle and apparatus for carrying out the method. Frutschi, H. (to BBC Brown, Boveri and Co., Ltd.). US Patent 4,148,191. 10 Apr 1979. Priority date 23 Dec 1975, Switzerland, 8p.

The invention discloses an arrangement for controlling the power output of a closed cycle type of thermodynamic system including shaft-coupled compressor and gas turbine components driving a load such as an electrical generator in which the gaseous working medium flows in a closed circulation system that includes a device for imparting heat to the gas and a storage tank for the gas connected in parallel with a section of the gas circulation system. In order to vary the power output, gas from the circulation system in a cold or hot state, respectively, is flowed through the tank for heat exchange with the gas in the tank such that as a result of the corresponding change produced in the density of the gas within the tank, gas is selectively withdrawn from or delivered into the circulation system.

42840 Forced-flow steam generator. Miszak, P. (to Sulzer Brothers Ltd.). US Patent 4,144,846. 20 Mar 1979. Filed date 27 Sep 1977. 8p.

The forced-flow steam generator is provided with a control means for controlling the amount of water fed to the evaporator. The control means includes a controller which receives a load-dependent signal and an actual value signal from a temperature measuring means. The steam generator includes an injection line which communicates at a point downstream of the temperature measuring means. The controller may be connected directly to a valve in the injection line in order to regulate the amount of water which is bypassed around the evaporator or may be connected directly to the feedwater supply to maintain a constant flow to the evaporator during injection of water.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 43208, 43327

42841 (AED-CONF—78-155-060) **District heat from large power plants.** Bald, A.; Charlier, J. (Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). 1978. 6p. (In German). (CONF-7804102—35). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Systems exhibition energy within the context of the Hannover fair; Hannover, F.R. Germany (19 Apr 1978).

42842 (CONF-7808102—, pp 17p, Paper 7) **Chasing Btu's or subatmospheric gas turbines to generate power.** Mackay, R. Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Btu's lurk in every high-temperature stack, whether the stack belongs to a manufacturing process, a fume incinerator, a gas turbine, or a reciprocating engine. Fires fueled by low-Btu gas, wood chips, agricultural wastes, or other biomass offer good potential. It is noted that these sources are usually at atmospheric pressure. In most cases, the energy recovered is passed through a heat exchanger and used simply to produce lower-grade heat. Domestic hot water, comfort heating, process steam, and process heat are typical outputs. By First Law standards, the efficiency is excellent. By Second Law standards, however, the efficiency is poor. Assuming the source heat has a reasonably high temperature, some of those thermal Btu's could be converted to high-value mechanical or electrical Btu's while the remainder would still be useful as heat. Two subatmospheric gas turbines currently under development at the AiResearch Manufacturing Company of California are described. Both can generate power using only the energy contained in hot gases at atmospheric pressure. The heat pump and the glass furnace programs will be the first practical applications.

42843 (CONF-7808102—, pp 17p, Paper 8) **Waste heat recovery from industrial processes using Brayton-cycle turbine technology.** Huetter, J.J. Jr.; Williams, T.D. (Alpha Glass, Inc., El Segundo, CA). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

A method is described for increasing the efficiency of a variety of energy-intensive industrial furnaces by up to 50% through the application of hot gas-turbine technology being developed by Alpha Glass, Inc. and Garrett AiResearch. A conservation demonstration program is underway to validate the concept of using Brayton-cycle turbine technology for energy recuperation, generation, and displacement. Initial system design uses validated materials and components subsequent to technology validation. The system is intended to be complementary to other energy-conservation methods. Though applicable to many industrial environments, the glass industry is specified as the prime candidate for use of this technology and for the supporting economic and technical risk analyses. A cooperative demonstration program is being conducted by Alpha Glass, Inc. with a Norton Simon Industries' subsidiary, Glass Container Corporation, at their Vernon, California plant.

ECONOMICS

REFER ALSO TO CITATION(S) 42528, 43242, 43243

42844 (DOE/EIA—0075/10(78)) **Cost and quality of fuels for electric utility plants. Monthly report: data for October 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1979. 66p. Dep. NTIS, PC A04/MF A01.

Electric-generating plants with a total combined capacity of 25 MW or greater purchased fossil fuels equivalent to 1.53 quadrillion Btu's in October, of which 99% was for steam-electric generation. Measured by their total heat content, fossil-fuel purchases for steam-electric generation were down 3.1% from last month and down 1.8% from October 1977. The total coal deliveries during the month of October 1978 were 46.3, a decrease of 400,000 tons below shipments delivered in October 1977. Oil purchases for steam-electric generation were 41.4 million barrels this month, which was an increase of 500,000 barrels above shipments delivered in October 1977. Gas deliveries to steam-electric units totaled 247 billion cubic feet (Bcf), down 18.7 Bcf from last year's level. In October, the price of coal averaged 114.0 cents per million Btu, a 13.4% increase over the average price of a year ago. The average price of all oil delivered to steam plants was 219.8 cents per million Btu, a decrease of 1.4% compared to October 1977. Steam gas prices continued to rise and averaged 147.1 cents per million Btu, an increase of 5.5% over the October 1977 level. Tables highlight the relative changes in deliveries and prices of fossil fuels for steam-electric generation for October 1977 and October 1978.

42845 (LA-UR—79-1012) **Application of a composite cost method to investment decisions in the electric utility industry.** Loose, V.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-790459—1). Dep. NTIS, PC A02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

Generating unit size-reliability and scale-cost trade-offs are combined in a composite cost method for application to investment decisions. The method is applied to a utility system.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 43128, 43129, 43130, 43131

FUELS

REFER ALSO TO CITATION(S) 42503, 42831, 43248

42846 (EPA/600/9—78-013, pp 27p, EEED 106) **Fuel cycle for combustion turbine - steam turbine combined cycle power plant.** Cukor, P.M. Jun 1978.

In Comprehensive standards: the power generation case.

An illustrative data base is presented of material quantities and environmental effluents in the fuel cycle for a combustion turbine—steam turbine combined cycle power plant. Data were calculated for a 1000 Mw power plant fueled with either distillate fuel oil or natural gas. Results are shown in tables and on a fuel cycle flowsheet.

42847 (FE/EES—79/4) **Economics of retrofitting industrial boilers from oil to coal—oil mixture firing.** George, T.J. (Department of Energy, Morgantown, WV (USA). Process Evaluation Office). Feb 1979. 10p. Dep. NTIS, PC A02/MF A01.

The Process Evaluation Office has completed a preliminary cost study of industrial boilers for the Combustion Division, Pittsburgh Energy Technology Center, Department of Energy. The cost of firing No. 6 fuel oil boilers with coal—oil mixtures (COM) of 50 percent by weight coal was determined. For a given set of operating conditions, fuel savings to justify retrofit costs were determined for 100,000-, 500,000-, and 1,000,000-pound-per-hour steam boilers. The sensitivity of retrofit cost to load factors and to costs of No. 6 oil was examined.

42848 (NUREG—0246) **Fuel supply investment cost: coal and nuclear. Commercial electric power cost studies (6).** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Apr 1979. Contract EY-76-C-02-2477. 276p. (COO—2477-10). Dep. NTIS, PC A13/MF A01.

This study presents an accounting model for calculating the capital investment requirements for coal and nuclear fuel supply facilities. The study addresses mining, processing, fabrication, and transportation of coal and nuclear fuels. A generic example is provided, for coal from different sources, and for nuclear fuel. The relationship of capital investment requirements to delivered prices is included in each example.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42151, 42271, 42846, 43245, 43494, 43731, 43733, 43737, 43746, 43766, 43840

42849 (EPRI-EA—1038) **Ecosystem effects of phytoplankton and zooplankton entrainment.** (Lawler, Matusky and Skelly, Pearl River, NY (USA)). Apr 1979. 226p. Dep. NTIS, PC A11/MF A01.

The literature on the effects of power plant entrainment on phytoplankton and zooplankton was reviewed to determine if a definitive documentation and assessment of the ecosystem effects of entrainment on these organism groups could be made. Few studies were found that attempted to address the ecosystem level directly, and many were designed only to meet regulatory requirements for assessment studies. Many shortcomings were found in these studies. While these studies cannot be said to provide a definitive assessment at tne ecosystem level, they do provide a large, consistent data base to document that the effects of entrainment on phytoplankton and zooplankton are generally small and unlikely to cause ecosystem-wide impacts. Except where the percentage of available water withdrawn for cooling is large or other evidence sugggests a unique situation, there is no need to conduct field studies on entrainment effects on a routine basis.

42850 (PB—287834) **Appendix to Entrainment at a Once-Through Cooling System on Western Lake Erie. Volume II. Appendices. Final report 1 Sep 72-31 Dec 75.** Cole, R.A. (Michigan State Univ., East Lansing (USA)). Aug 1978. 258p. NTIS PC A12/MF A01.

The report is a compilation of data for Entrainment at a Once-Through Cooling System on Western Lake Erie.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 42217, 42268, 43232

42851 (AED-CONF—77-564-001) **Possibilities to design non-polluting coal-fired power plants.** Bohn, T.J. (Essen Univ. (Gesamthochschule) (Germany, F.R.)). 1977. 19p. (In German). (CONF-7711102—3). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Conference on possibilities of designing coal energy production facilities not harmful to the environment and gas purifi-

cation in connection with thermal power stations; Essen, F.R. Germany (17 Nov 1977).

The status of power supply in West Germany and of hard coal in the power industry is presented. The status of the electric power industry is outlined, and tasks for technical improvements in coal-fired plants are derived.

42852 Ferrous ion scrubbing of flue gas. DeBerry, D.W. (to Southern California Edison Co.). US Patent 4,126,529. 21 Nov 1978. Filed date 5 Aug 1977. 8p.

An apparatus and method are disclosed for removing oxides of nitrogen and sulfur from flue gases. The apparatus comprises an enclosure wherein the flue gases are washed with a scrubbing solution, preferably containing ferrous chelates and sulfite ions, and an electrochemical cell for regenerating the spent scrubbing solution. The electrochemical cell preferably comprises a plurality of cathode and anode compartments separated by ion transfer membranes. The spent scrubbing solution is regenerated by passing the solution through the cathode compartments of the electrochemical cell. The regeneration process involves the removal of the sulfate ions from the scrubbing solutions through the ion transfer membranes and rhe reduction of the nonreactive ferric chelate to the reactive ferrous chelate.

42853 Emissions from a coal-fired power plant: a material balance study of selected volatile trace elements. Moore, G.T. Cincinnati, OH; Univ. of Cincinnati (1978). 113p. University Microfilms Order No. 7904752.

Thesis (Ph. D.).

Arsenic (As), selenium (Se), and nickel (Ni), because of their volatility and potential toxicity are a subject of environmental concern. Recent studies of trace element emissions from coal-fired power plants have revealed negative mass balances for these elements. This, however, was attributable to inefficient sampling methods. Therefore the objectives of this present work were threefold: (1) to determine effective material balances for As, Se, and Ni; (2) to develop efficient sampling and analytical methods for these trace elements; and (3) to utilize sulfur as an internal standard in the determination of enrichment factors for the three elements. It was also proposed to compare the enrichment factors calculated using S as the base element with results using the more usual nonvolatile element aluminum (Al). As and Se were measured from the evolution of arsine (AsH_3) and hydrogen selenide (H_2Se), respectively. Both hydrides were formed by the reaction of the ionic species As or Se with hydrogen ions that are generated by the addition of sodium borohydride pellets in hydrochloric acid. A unique aspect of this analysis was that it was performed using an atomic absorption spectrophotometer (AAS), equipped with a hollow cathode lamp and a hydrogen continuum source for background correction. Ni in coal, ash and filters was determined at its primary wavelength of 232.0 nm by AAS.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 42830

42854 Method of testing gas insulated systems for the presence of conducting particles utilizing a gas mixture of nitrogen and sulfur hexafluoride. Wootton, R.E. (to Dept. of Energy). US Patent 4,135,130. 16 Jan 1979. Filed date 29 Jun 1977. 4p.

PAT-APPL-811,230.

A method of testing a gas insulated system for the presence of conducting particles is presented. The method includes inserting a gaseous mixture comprising about 98 vol % nitrogen and about 2 vol % sulfur hexafluoride into the gas insulated system at a pressure greater than 60 lb psig, and then applying a test voltage to the system. If particles are present within the system, the gaseous mixture will break down, providing an indicator of the presence of the particles.

42855 Premolded splice for 138kv extruded dielectric cable. Edgerton, N.W. (Amerace Corp, Hackettstown, NJ). *IEEE Trans. Power Appar. Syst.;* **PAS-97**: No. 6, 2178-2186(Nov-Dec 1978).

Premolded interference-fit splices for 138 kV solid dielectric cable have been manufactured and have passed the required design qualification tests. These splices were developed in a research project jointly sponsored by the Electric Power Research Institute and the Energy Research and Development Administration. The splices offer significant advantages in ease of assembly and in reliability as a result of pretesting at the factory. A discussion of the paper is appended.

42856 Summary of utility load management programs. Cambridge, MA; Arthur D. Little, Inc. (1978). 35p. (NP—22571). Electric Power Research Inst., P. O. Box 10412, Palo Alto, CA.

There are several categories of utility load management programs which have proven to be successful on specific utilities in the USA. These proven categories include: control of conventional, residential water heaters; control of conventional, residential central air conditioning systems; control of room-sized residential heating systems incorporating energy storage; and control of irrigation pump motors. In addition, there are load management programs which include the following categories: new large-capacity residential water heaters, with inherent energy storage capability; new central residential heating systems incorporating energy storage; new dual-fuel residential heating systems; interlocks, which prohibit the simultaneous use of two or three major home appliances; new intelligent control systems for residential heating and cooling systems; and new indicator devices for the home, which tell the consumer when peak rates are in effect. The status of each category is discussed, and specific data on numbers of devices and utilities are presented.

AC SYSTEMS, EHV AND UHV

REFER ALSO TO CITATION(S) 42866, 42867, 42869, 42870

42857 (AD-A—060323) **Anacapa Island split pipe inspection of June 1977 and April 1978. Technical note, Sep 74-Jun 78.** Tausig, W.R.; Brackett, R.L. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Sep 1978. 32p. NTIS PC A03/MF A01.

The U.S. Navy currently maintains and operates numerous underwater power and signal cables. Most of these cables utilize split pipe systems to protect the cable from damage in the surf zone and when crossing exposed rocky seafloors. Past experience has shown that the hardware used to install the split pipe system lacks the reliability and maintenance-free operation required for the life of the cables. Based on previous experience with cable failures, the areas determined to be in greatest need of investigation are fasteners for holding the split pipe halves together, immobilization of the pipe, and cathodic protection for the entire system. As a result, CEL tested prototype and commercially available hardware components which appeared to be suitable replacements for the existing split pipe hardware. The candidate hardware was then used in a 300-ft-long test section of split pipe installed March 1976 at Anacapa Island, to be inspected during a five-year period. Results of the CEL hardware tests, Anacapa pipe installation, and first inspection are documented in TN-1498. This report is a follow-up to TN-1498 and presents the results of the test installation inspections for June 1977 and April 1978; the second and third inspections to be made since the March 1976 installation was completed.

42858 (DOE/CS/3029—T1) **Elimination of particle effects in SF_6 insulated transmission systems. Second quarterly report, January 1—March 31, 1979.** Dale, S.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1979. Contract ET-78-C-01-3029. 46p. Dep. NTIS, PC A03/MF A01.

The purpose of this program is to develop methods and equipment to eliminate the adverse effect of particle contamination in SF_6-insulated transmission systems, CGIT, so that the excellent dielectric properties of SF_6 can be fully exploited. The program consists of three major parts: theoretical and experimental evaluation of concepts; optimization and verification studies in CGIT systems; reliability analysis, documentation of designs and economic analysis. The mode of particle trapping with an elevated particle trap is shown to be dependent on particle size. Tests with dc voltages show that particles can escape from the trap area. Closing the end openings of the trap can prevent this, but interfere with the trapping of small particles. The use on an adhesive material contained particles in the trap and allowed trapping of small particles. Three candidate adhesive materials were selected for further extensive aging studies. Tests on the adhesive materials showed that wire particles lying flat on the surface can not be pulled off the adhesive at fields of 145 kV/cm which is some 2 x 10^3 larger than the field normally inside the particle trap. Traps mounted around the insulators can prevent particles from initiating flashover of the insulator. Insulators without traps can cause large particles to be trapped under the insulator. The concept of using conical barriers mounted around the solid insulators to prevent particles from contaminating the insulator looks promising if used together with an elevated particle trap. A method of usinga tunable oscillating diaphragm was tested for evaluating the static electric adhesion properties of candidate insulating materials. Preliminary tcsts indicate that the charge required for adhesion of a particle is not a simple function of the dielectric constant of the materials.

42859 (HCP/T5054—01) **Final report on preliminary dielectric studies. Spir-o-line cable for application at power frequencies.** Engelhardt, J.S. (Engelhardt (John S.) Underground Systems, Inc., Armonk, NY (USA)). 4 Dec 1978. Contract EG-77-C-01-5054. 55p. Dep. NTIS, PC A04/MF A01.

Preliminary studies were made on a unique dielectric system for both flexible and rigid power cable applications. Known as Spir-

O-Line, it was developed and is manufactured by Prodelin, Inc. as a high power radio frequency transmisson system, with a service record of several decades. The cable consists of a central conductor continuously supported by six high density polyethylene tubes inside a metal sheath, which operates as a GITL with either nitrogen or SF_6 as the filling medium. A rough analysis of the dielectric geometry concluded that its breakdown strength might be improved over that of the open coaxial conductor configuration. A series of breakdown tests was performed on the smaller range of commercially available sizes. The results confirmed the expected behavior patterns, but did not fully explore the upper units of performance due to occasional tube separations in the samples tested. The potential voltage ratings of the larger available sizes were estimated and found to be from 69 kV to 138 kV for a 3-inch O.D. size, and from 138 kV to 230 kV for a 6-inch O.D. size. There is considerable flexibility in the design of the conductor due to the continuous support of the dielectric tubes. In addition, the system enjoys efficient utilization of material and a low cost, low energy manufacturing process. The system economics appear competitive with conventional systems at conventional power ratings. For these reasons, a full-scale development and demonstration project is strongly recommended.

42860 Device for connecting tuned power transmission line to ac network. Lukashov, E.S.; Yakobson, M.K. (to Sibirski Nauchno-Issledovatelsky Institut Energeriki). US Patent 4,127,805. 28 Nov 1978. Filed date 28 Dec 1976. 10p.

A device is disclosed for connecting a tuned power transmission line to an ac network includes the following units that are serially interconnected in any combination: a phase transposition unit for phase shifting the voltage through an angle which is a multiple of the natural shift of voltages of opposite phases; a coupling transformer with a switchable group of connections of its windings, which matches the voltages of the tuned power transmission line and the ac network and effects a voltage phase shift which is a multiple of 180°; and a transverse voltage regulation transformer which makes it possible to smoothly change the voltage phase shift under load.

DC SYSTEMS

REFER ALSO TO CITATION(S) 42874, 43128, 43129, 43130, 43131

42861 (CONF-781192—) **Symposium on HVDC power transmisson.** (Bonneville Power Administration, Portland, OR (USA); Department of Energy, Washington, DC (USA)). 1978. 317p. Dep. NTIS, PC A14/MF A01.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

Twelve papers were presented at the meeting. A separate abstract was prepared for each paper.

42862 (CONF-781192—, pp 1-40) **Study on overhead Volgograd—Donbass power transmission monopolar line to ground fault.** Gertsik, K.A.; Ivaov, V.E.; Kadomskii, D.E.; Talover'ya, V.L. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The investigation of transient phenomena in dc electric power transmission and in the presence of faults to the ground of the one of overhead power conductors, has shown that the character of these phenomena affects directly the indicators of the power transmission reliability. The conductor to ground fault is accompanied by excessive voltages developing on the unfaulted overhead conductor and may result in either the flashover of its insulation or in an operation of a line arrester. As a result, a fault occurring on one conductor of the power transmission line may develop into the simultaneous fault on both conductors. The data and results of the experimental studies which have been carried out on the Volgograd-Donbass 200-kV dc transmission line are analyzed and the appropriate computational studies are presented. These were compared to the experimental data. The applicability of the suggested methodology in the study of transient phenomena which occur as a result of the line-to-ground fault on one of the overhead conductors of dc power transmission is discussed.

42863 (CONF-781192—, pp 41-68) **Transient overvoltages on the Pacific HVDC Intertie during monopolar line fault tests.** Melvold, D.J. (Los Angeles Dept. of Water and Power); Vithayathil, J.J. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

In order to retain the double circuit characteristics of a bipolar EHV dc overhead line, it is necessary to design the line to withstand transient overvoltages occurring in one pole due to line-to-ground faults in the other pole. The design criteria for the air clearances of the bipolar line are often dictated by the maximum overvoltages occurring under this fault condition. A series of tests was performed on the 1350 km (846 miles) Pacific HVDC Intertie System. The transient overvoltages observed during staged monopolar line-to-ground faults are reported. The field data reported should give a good indication of the nature of overvoltages to be expected on an unfaulted pole of a bipolar line for a monopolar line-to-ground fault for dc lines similar to the Pacific HVDC Intertie. Close agreement was obtained between simulation results and field data. The simulation results conclusively showed that, for this type of overvoltage studies, it is important to properly model the frequency-dependent characteristics of the line parameters in the zero-sequence and positive-sequence modes. The results show that the maximum overvoltage on the unfaulted pole for the monopolar fault varies along the length of the line. It is, therefore, possible to obtain a design of long dc lines with different overvoltage criteria for different sections of the line.

42864 (CONF-781192—, pp 69-83) **Type of disturbances in dc power transmission on Volgograd—Donbass line. Efficiency of automatic reclosure (AR) and determination of open arc extinguishing time through testing on overhead transmisson line. Evaluation of dc transmission line operations without overhead ground wire.** Korsuntsev, A.V.; Meshkovskii, V.K.; Teterin, V.P. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

Data are presented on the characteristics and performance of the 400 kV, 470 km-long dc power transmission line from Volgograd to Donbass, USSR in order to evaluate the efficiency of automatic reclosure and to determine the open arc extinguishing time during operation of the line without overhead ground wires. It was concluded that: at the present time, the overwhelming matority of disturbances in dc power transmisson in the Volgograd—Donbass line are related to the insufficiently reliable operation of mercury rectifiers and equipment which has used up its useful service life in the 15 years of its use, and in addition to the low level of outer insulation, design deficiencies of some devices and the experimental testing of a sufficiently large number of new devices; operating experience and experiments made on extinction of an open arc on an aerial line insulation show that automatic reclosure is also an effective means of improving reliable power supply in a dc power transmission system; and estimation of the number of lightning flashovers and lightning overvoltage waves as it applies to dc power transmission in the Volgograd—Donbass line provides no grounds for speaking about an acceptable dc power transmission operation without an overhead lightning protection cable over the entire length of the line.

42865 (CONF-781192—, pp 87-97) **Lightning outage performance of overhead HVDC transmission lines.** Perry, D.E.; Sarkinen, S.H. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The expected performance of a +-400-kV, dc transmission line is described along with the operating experience over a seven-year period of the +-400-kV, 846-mile long Pacific Intertie Line located in the western United States. The critical parameters used in the analysis of a proposed +-600-kV d-c line are also discussed. Critical factors used in this analysis are isokeraunic level, shielding, tower footing resistance, tower height and line insulation levels.

42866 (CONF-781192—, pp 99-149) **Mutual influence of dc and ac power transmission systems due to the ac harmonics.** Kraichik, Yu.S.; Posse, A.V. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The mutual effects between dc and ac transmission systems and particularly the effects of higher harmonics in converter substation currents and in the voltages at the busbars are discussed. Methods for calculating impedence-frequency parameters (IFP) within the networks connected to the transforming substations and the use of these computations in selecting substation filters are presented. It is concluded that these calculations, which are complex and which do not yield precise values of IFP, do make it possible to estimate the regions of possible IFP and to elucidate which of the parameters affect the IFP most, and that experimental verification of IFP can be carried out. (LCL)

42867 (CONF-781192—, pp 151-191) **HVDC—ac system interaction from ac harmonics.** Hingorani, N.G. (Electric Power Research Inst., Palo Alto, CA); Vancers, I.; Hauth, R.L.; Lasseter, R.H.; Lindh, C.B.; Numrich, F.H.; Price, W.W. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The Electric Power Research Institute (EPRI) has sponsored a research project which is centered around the development of a

measuring method to determine the harmonic impedance of the Bonneville Power Administration's (BPA) system as seen from the supply bus at Big Eddy Substation leading to the Celilo HVDC Station about a mile distance from the Big Eddy Substation. The research attempts to use the inherent harmonics in the system as well as harmonics from the Celilo converter station for the determination of the systems harmonic impedance. The measuring technique is discussed, the instrumentation is indicated as well as the data processing. Another phase of the research is to compare measured values with calculated harmonic impedance values from the BPA system data. The overall objective is to refine calculations for utilities contemplating HVDC installations of the characterization of their system harmonic impedance. These impedance values can then be used by the filter designer. A filter current monitoring installation is described. The filter current monitoring is used to determine system conditions which may arise giving higher filter currents than precalculated values. A state-of-the-art filter design methodology is outlined. A discussion of filter design economics is given when a full knowledge of the system harmonic impedance is indicated.

42868 (CONF-781192—, pp 193-216) **Ensuring reliable operation of high capacity direct current power transmisson systems.** Berkh, I.M.; Koshcheyev, L.A.; Marchenko, E.A.;. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

Studies were made of the stability and regulating capacity of HVDC transmission systems using mathematical models for direct calculation of the transient processes and a physical model of an HVDC system. It was found that maintenance of inverter stability during faults in a direct current circuit, as well as rapid restoration of direct current transmisson capacity in those cases when a fault occurs in alternating current systems, are most important to the question of reliability of power supply systems with high capacity direct current transmissions. Studies have indicated the possibility of developing converter regulating systems, which would make it possible to fulfill these conditions. The capacity of autonomous power regulation of direct current transmissions can be used for antifault control and for localizing the development of faults in a power system. The effectiveness of regulation for these purposes is determined to a significant degree by the connecting system and the composition and characteristics of the reactive power sources of the inverter substations. Boosting direct current transmission power is practically equivalent to a simultaneous cutoff of consumers by automatic antifault equipment and dumping of turbogenerators of corresponding power. It is the most preferred antifault measure for maintaining stability of parallel operation of power systems through alternating current interties which parallel direct current transmissions. (LCL)

42869 (CONF-781192—, pp 217-239) **Control systems for interaction of the Pacific dc Intertie with the ac system.** Vithayathil, J.J.; Mittelstadt, W.A. (Bonneville Power Administration, Kalispell, MT). 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The western U.S. power system, comprising the Western Systems Coordinating Council (WSCC), includes all or part of the fourteen western states, and British Columbia. These interconnected systems operate about 74,000 miles of transmission lines 115 kV and higher, and have a total installed generating capacity of about 92,500 MW. The 500-kV Pacific ac Intertie is the primary alternating-current interconnectin between the Northwest and Southwest. This Intertie is composed of two lines with a total rating of 2500 MW. A system of 230-kV ties extending around the eastern side of the system also connects the two regions. In addition to the ac interties, the +-400-kV bipolar direct-current Pacific dc intertie provides a 1440 MW interconnection betwen the Pacific Northwest and the Los Angeles area. The ac and dc interties together form a parallel ac/dc system, where disturbances in one affect the operation of the other. The control or switching actions used in the dc or ac system to minimize the impact of disturbance in the other system and to improve the overall performance of the western power system are described.

42870 (CONF-781192—, pp 241-264) **Control system interactions in the Square Butte ac—dc system.** Bahrman, M.P. (Minnesota Power and Light, Jackson). 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The Square Butte HVDC Control System is described with regard to the interaction between the ac and dc systems. The regulator control modes and valve firing system are described along with auxiliary controls for system damping. Interaction between these controls and torsional modes of nearby steam turbine generators is discussed.

42871 (CONF-781192—, pp 265-285) **Pacific HVDC Intertie control system experience.** Vithayathil, J.J. (Bonneville Power Administration, Kalispell, MT); Shockley, P.R. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The Pacific Northwest—Southwest HVDC Intertie is a 1361 km-long overhead transmission system between the Celilo Converter Station in The Dalles, Oregon, and the Sylmar Converter Station near Los Angeles, California. The Intertie is rated +-400 kV, 1440 MW. There are six six-pulse mercury-arc converter groups, three per pole, connected in series at each terminal. The main circuits for the northern and southern sections of this transmission system are shown. The Intertie was commissioned on May 21, 1970. The main features of the control and protection systems of the Intertie and their performance during commercial operation are described.

42872 (CONF-781192—, pp 287-306) **Initial Square Butte HVDC control system experience.** Bahrman, M.P. (Minnesota Power and Light, Duluth); Vancers, I. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The control system for the Square Butte HVDC System is described with particular emphasis on its transient performance. Expected performance is discussed and compared with performance during actual system disturbances. Examples are given for ac system faults at the rectifier, ac system faults at the inverter and dc line faults.

42873 (CONF-781192—, pp 307-313) **Initial HVDC control system experience: David A. Hamil back-to-back tie at Stegall.** Reikofski, C. 1978.

From HVDC power transmission conference; Portland, OR, USA (28 Nov 1978).

The design and performance of a control system for the David A. Hamil HVDC Intertie which began operation in 1977 are discussed. The tie was constructed to permit delivery of power from a resource from the eastern interconnected systems to a load within the western interconnected systems of the U.S. Previous attempts for synchronous operation of these two interconnected systems had to be abandoned because of inadequate ac transmission between these two high inertia systems. The tie employs solid state technology and is rated at 110 MW continuous. The tie is monopolar with each terminal employing 2 to 6 pulse bridges in series providing a 50 kV dc output. The converter transformers are 3-phase, 3-winding, 230 kV/grounded wye, 21,800 delta, 21,800/12,588 wye. Tap changers are provided on the 230 kV windings.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

42874 (LA-UR—79-1057) **dc superconducting cables.** Keller, W.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-26. 27p. (CONF-790527—1). Dep. NTIS, PC A03/MF A01.

From Workshop on public policy aspects of high capacity electric power transmission; Aspen, CO, USA (14 May 1979).

Progress in the development of dc superconducting cables suggests these systems will provide an attractive alternate among cable options where long lengths of high-capacity underground transmission lines are required. The general characteristics of dc superconducting cables as well as details of two specific designs, one coaxial and the other double monopolar, are discussed. The special advantages of these cables lie in the relative simplicity of construction, their extremely high operating efficiency, and their compactness when compared with other ac or dc high-capacity cables cooled by flowing fluids, either at ambient or cryogenic temperatures. These features are discussed in the context of economic, environmental, and power system considerations, including some of the possible trade-offs among conventional and superconducting ac and dc systems.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 42457, 43205, 43240, 43401

42875 (DOE/ET—0030/1(79)) **US central station nuclear electric generating units: significant milestones (status as of January 1, 1979).** (Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development). Mar 1979. 26p. Dep. NTIS, PC A03/MF A01.

Construction and operational milestones are tabulated for US nuclear power plants. Data are presented on nuclear steam supply

system orders. A schedule of commercial operation and projected capital costs through 1990 is given.

42876 (UCB/EERC—79/07) **Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 1, summary report.** Spencer, P.N.; Zackay, V.F.; Parker, E.R. (California Univ., Berkeley (USA). Coll. of Engineering). Feb 1979. Contract EY-76-S-03-0034-269. 179p. Dep. NTIS, PC A09/MF A01.

The long-range objectives are to significantly enhance safety and reduce operational costs for nuclear power plants. This would be done through utilizing, in piping system restrainer devices, the very large energy-absorbing capabilities of certain steels undergoing plastic deformation. Specifically, the objectives are: (1) to develop an analytic program confirming the viability of elastic-inelastic deformation of restrainer devices as a means of controlling piping responses during seismic events and during extreme loadings caused by operational events such as water hammer, pipe whip, etc.; (2) to develop solid-state, energy-absorbing restrainers capable of meeting the criteria of the analytic program, and to confirm their behavior through experimental testing programs including shaking-table tests; and (3) to convert (1) and (2) into a code position acceptable to the appropriate ASME committees and the U.S. Nuclear Regulatory Commission.

42877 **Review of August 1978 changes to the NRC's program for standardization of nuclear power plants.** Kane, W.F. (Nuclear Regulatory Commission, Washington, DC). *Nucl. Saf.;* 20: No. 3, 258-266(May 1979).

The Nuclear Regulatory Commission's (NRC's) standardization program for the licensing of nuclear power plants was initiated in April 1972 and has been used extensively by industry since that time. In June 1977 the NRC directed the staff to undertake a detailed study of the program. As part of that study, the staff was to determine steps that the NRC might take to further encourage standardization. The article discusses the changes made to the standardization program that resulted from that study.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 42841, 42924, 42989, 42994, 42995, 42996, 43011, 43024, 43028, 43032, 43039, 43078, 43102, 43110

42878 (CAAP-TR—050) **FRAPCON-1: a computer code for the steady state analysis of oxide fuel rods.** Laats, E.T.; Peeler, G.B.; Scofield, N.R. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1979. Contract EY-76-C-07-1570. 141p. Dep. NTIS, PC A07/MF A01.

The predictive capabilities of the steady state fuel rod behavior program, FRAPCON-1, have been independently assessed. Predictions of fuel behavior generated by the FRAPCON-1 code are compared with experimental data for test rods and with predictions from the FRAP-S3 code for commercial design rods. The code-data comparisons are used to assess the accuracy of fuel rod thermal, pressure, deformation, and corrosion models under steady state operating conditions. The code-code comparisons are used to identify the effects of model differences between FRAPCON-1 and the previously assessed fuel behavior code, FRAP-S3. Based on the results of these studies, conclusions are given regarding present model capabilities and future development needs.

42879 (CDAP-TR—055) **Fuel behavior model development: FRAPCON-2 uncertainty analysis option.** Peck, S.O. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 39p. PC E02/MF E02.

An automated uncertainty analysis option has been added to the FRAPCON Computer Code. The option allows the user to obtain estimates of the uncertainty in computer output variables of the code as a function of known uncertainties in input variables. The method of uncertainty analysis used is the Response Surface Method (RSM). Results of the uncertainty analysis option include estimates of the mean and variance of the output variables plus fractional contributions to that variance due to each of the input variables. An example application of the method to FRAPCON standard problem number one is presented.

42880 (EPRI-NP—1033) **Literature review of dilute chemical decontamination processes for water-cooled nuclear reactors.** Choppin, G.R.; Dillon, R.L.; Griggs, B.; Johnson, A.B. Jr.; Remark, J.F.; Martell, A.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 216p. Dep. NTIS, PC A10/MF A01.

Decontamination of nuclear reactors denotes removal of radioactive species from systems or components, generally by the action of chemical reagents. Historically, decontamination of reactor primary systems has involved a campaign-type method, utilizing relatively concentrated reagents (5 to 15 wt %), typically requiring months of reactor outage. Major decontamination outages have occurred infrequently, generally in response to an unusual need such as a required component inspection or repair. Milder, but relatively frequent decontaminations have potential capability to reduce average primary system radiation levels. This report examines that option and surveys potential decontamination reagents which could function effectively at concentrations below 1000 wt. ppM. This review is made in support of an EPRI program to investigate reagents for application in BWR and PWR primary systems. The principal class of compounds considered in this survey is organic chelating agents, emphasizing compounds containing carbon, hydrogen, nitrogen, and oxygen. The survey attempted to collect information regarding elevated temperature properties of the potential reagents, including solubilities, thermal and radiation stabilities and high temperature stability constants for complexing metal species. Numerous literature references are cited which provide thermodynamic properties at room temperature. Very little information relative to the desired temperature regime (90 to 200°C) was found. Also there is a general lack of information regarding reactions of chelating agents with solid oxides and metals, especially kinetic data.

42881 (NUREG—0554) **Single-failure-proof cranes for nuclear power plants.** Porse, L. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development). May 1979. 15p. NTIS, PC A02/MF A01.

NRC has licensed reactors on the basis that the safe handling of critical loads can be accomplished by adding safety features to the handling equipment, by adding special features to the structures and areas over which the critical load is carried, or by a combination of the two. When reliance for the safe handling of critical loads is placed on the crane system itself, the system should be designed so that a single failure will not result in the loss of the capability of the system to safely retain the load. Features of the design, fabrication, installation, inspection, testing, and operation of single-failure-proof overhead crane handling systems that are used for handling critical loads are identified. These features are limited to the hoisting system and to braking systems for trolley and bridge. Other load-bearing items such as girders should be conservatively designed but need not be considered single failure proof.

42882 (NUREG/CR—0390) **Fatigue growth in piping and rpv steels in simulated BWR water environment.** Hale, D.A.; Yuen, J.L.; Gerber, T.L. (General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Aug 1978. 87p. (GEAP—24098). NTIS, PC A05/MF A01.

This report summarizes results of an experimental testing program focused on establishing the fatigue crack growth behavior of several commercial pressure vessel and piping steels typically used in light water reactors. Testing was done in a simulated boiling water reactor (BWR) primary water environment (1230 psig, 550°F demineralized water). The data obtained were analyzed using linear elastic fracture mechanics principles and, in the case of the reactor pressure vessel alloy steel, compared to existing ASME design codes. The results show that crack growth rates are increased in this BWR water environment by decreasing the frequency of cyclic loading or increasing the mean load present during the load cycle. However, in the case of the pressure vessel alloy steel, these effects are moderated by transverse secondary microcracking, which is a manifestation of a crack tip chemistry interaction for this environment/material pair. This behavior is consistent with previous GE experience with in-service cracking in pressure vessel components, wherein analytic projections of cracking rates always tend to overpredict crack depths when compared to actual field observations. The results for the Type-304 stainless steel and the Inconel 600 establish threshold values on cyclic loading frequency for intergranular stress corrosion cracking behavior in these two material/environment pairs.

42883 (ORNL/RSIC—43) **Radiation streaming in power reactors.** Lahti, G.P.; Lee, R.R.; Courtney, J.C. (eds.). (Oak Ridge National Lab., TN (USA)). Feb 1979. Contract W-7405-ENG-26. 201p. (ANS/SD—79/16; CONF-7811109—P1; CONF-781105—P1). Dep. NTIS, PC A10/MF A01.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Separate abstracts are included for each of the 14 papers given at a special session on Radiation Streaming in Power Reactors held on November 15 at the American Nuclear Society 1978 Winter Meeting in Washington, D.C. The papers describe the methods of calculation, the engineering of shields, and the measurement of radiation environments within the containments of light water power reactors. Comparisons of measured and calculated data are used to determine the accuracy of computer predictions of the radiation

environment. Specific computational and measurement techniques are described and evaluated. Emphasis is on radiation streaming in the annular region between the reactor vesel and the primary shield and its resultant environment within the primary containment.

42884 (ORNL/RSIC—43, pp 1-21) **Neutron flux determination in the reactor cavities of LWRs.** Rahn, R.; Till, H. (Electric Power Research Inst., Palo Alto, CA). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

The streaming of neutrons in the cavity of an LWR is basically controlled by two phenomena: the transport of source neutrons may mean free paths from the core to the outer edge of the pressure vessel through dense materials, and once in the near vacuum cavity, the interaction of the neutrons with the steel and canned concrete which comprises the boundary of the cavity region. The geometrical relationship of the peripheral fuel assemblies in the core to the cavity is shown to be important in determining the magnitude of the neutron flux in the cavity. An albedo scattering data base is presented which applied scattering from both the concrete shield and the low carbon steel pressure vessel. This permits a more simplified neutron transport calculation of cavity streaming, and reduces computer time substantially.

42885 (ORNL/RSIC—43, pp 22-27) **Analysis of reactor cavity radiation streaming: some practical considerations.** Simmons, G.L. (Science Applications, Inc., La Jolla, CA). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

A description is presented of a cost effective analysis procedure for use in the prediction of radiation environments in the cavity and containment building of a nuclear power reactor. Comments are offered on potential problems in certification of analysis procedures and the availability of benchmarkable data sets, both measurements and calculations.

42886 (ORNL/RSIC—43, pp 178-192) **Shield design against neutron streaming in the vicinity of a BWR pressure vessel.** Seifferth, L.; Przibram, E.; Hock, R. (Kraftwerk Union AG, Frankfurt, Germany). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

In nuclear power plants with boiling water reactor of KWU design, the area in which the motor of the internal recirculation pumps and the control rod drives are situated had to be made accessible even at full reactor power in order to increase the availability of the plant in case the pumps should require inspection, service, and possible repair. Because of very limited space and additional requirements for openings for air flow as well as the necessity of high temperature resistance, noninflamability and low heat conductivity, the solution of that problem was difficult. It could only be solved by a combination of calculation, measurement, and the stepwise introduction of shielding material. The final shield design is such that at full reactor power the dose rate of neutron- and gamma-radiation is 10 mrem/h in the inspection area and 50 to 100 mrem/h in the area where maintenancee work on motors may have to be performed.

42887 **Neutron noise to detect BWR-4 in-core instrument tube vibrations and impacting.** Fry, D.N.; Kryter, R.C.; Mathis, M.V.; Mott, J.E.; Robinson, J.C. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **43**: No. 1, 42-54(Apr 1979).

Noise analysis was used to investigate in-core instrument tube vibrations in boiling water reactor-4 (BWR-4)-type reactors. Neutron noise signals from in-core fission chambers and acoustic noise signals from externally mounted accelerometers were used in these studies. The results show that neutron noise can be used to detect vibration and, more important, impacting of instrument tubes against adjacent fuel channel boxes. Externally mounted accelerometers detect impacting but not rubbing of instrument tubes against fuel channel boxes. Accelerometers can monitor impacting only on the particular instrument tube where the accelerometer is mounted. Surveillance for instrument tube impacts can be accomplished using standard BWR-4 in-core power range neutron flux detectors at all instrument tube locations containing these detectors. Ex-vessel accelerometers can then be used to monitor instrument tubes that lack power range neutron flux detectors. However, noise on axial flux profiles obtained with movable in-core detectors is not a reliable indicator of impacting because the recorder used to plot the flux profiles does not respond adequately to the noise frequency generated by impacting. Neutron noise signatures show that modification of the bypass cooling by plugging preexisting holes and drilling new holes in the fuel assembly lower tie plate greatly reduces instrument tube vibration and eliminates impacting of instrument tubes against fuel boxes.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 42392, 42878, 42879, 42880, 42881, 42883, 42884, 42885, 42924, 42943, 42981, 42988, 42989, 42991, 42992, 42993, 42994, 42996, 43007, 43008, 43009, 43010, 43011, 43012, 43013, 43014, 43024, 43026, 43032, 43036, 43039, 43040, 43043, 43047, 43051, 43058, 43059, 43061, 43063, 43065, 43078, 43091, 43092, 43095, 43098, 43102, 43107, 43108, 43109, 43110, 43122, 43123

42888 (BNL-NUREG—24837) **Prediction of denting and associated Inconel 600 tube cracking on the primary side in PWR steam generators.** van Rooyen, D. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 23p. Dep. NTIS, PC A02/MF A01.

In order to predict denting in PWR steam generators with any degree of confidence, it is necessary to have at least a minimum qualitative and quantitative understanding of the factors involved in the rapid linear growth of Fe_3O_4 on carbon steel. Up to the present, such knowledge has been incomplete, both from the standpoint of the corrosion mechanisms and of the actual environmental conditions leading to denting in the field. This is emphasized by the fact that a lengthy exploration was made at this Symposium of possible factors that may account for the absence of denting in secondary systems of Japanese PWR units, while denting occurred in several units in the U.S.A. operating under apparently similar conditions. Of course, many reactions that may be involved in the rapid oxide growth that causes the problem have been suggested and a good deal of experimental evidence has come to light, as is discussed in this paper. This paper presents some ideas on factors that are involved or that have to be clarified in order to predict denting and its secondary effects. It also describes briefly the development of a probe that is underway at Brookhaven National Laboratory (BNL) for the early detection of localized corrosive conditions in secondary systems of nuclear power plants.

42889 (CEND—376) **Improvements in once-through PWR fuel cycles. Interim progress report, fiscal year 1978.** Decher, U.; Shapiro, N.L. (Combustion Engineering, Inc., Windsor, CT (USA)). Jan 1979. Contract EY-76-C-02-2426-005. 153p. Dep. NTIS, PC A08/MF A01.

The objective of this task is to quantify the potential reduction in U_3O_8 requirements and to establish the technical feasibility of various alternatives which have been proposed for improving the U_3O_8 utilization of the PWR for use in the Non-Proliferation Alternation System Assessment Program (NASAP) and for input to the Internal Fuel Cycle Evaluation (INFCE). The improvement results reported are of a preliminary nature. Further work is necessary using more detailed methods, to further quantity the improvement, and to establish the practicality of actually implementing the improvements in pressurized reactors.

42890 (ORNL/RSIC—43, pp 28-42) **Applications of Monte Carlo and discrete ordinates techniques to PWR cavity shield design.** Cavanaugh, G.P. (Combustion Engineering, Inc., Windsor, CT). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

The development and application of calculational techniques needed to establish the radiation shielding effectiveness of proposed shield designs for the annular cavity between PWR reactor vessels and the primary shield is presented. A computer code, MQT, developed at Combustion Engineering, Inc., to improve 2D S/sub N/ calculations by changing angular quadratures and/or spatial meshes between successive steps of bootstrapped S/sub N/ calculations is described. The development of MQT and its application has shown the need for high order asymmetric quadrature sets for the analysis of annular shields with small gaps. Monte Carlo calculations have been improved through the use of an annular surface source, the addition of an azimuthal dependence to that source, and the limitation of the number of thermal neutron interactions per history. A method has been developed using MQT to identify important streaming pathways in 2D and 3D calculations.

42891 (ORNL/RSIC—43, pp 43-53) **Reactor cavity radiation streaming.** Cardito, J.M.; Allen, P.R.; Eastman, E.A.B.; Wainio, K. (Stone and Webster Engineering Corp., Boston, MA). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

A methodology has been developed to predict neutron and gamma doses on the operating floors of PWR's due to radiation streaming from reactor cavities. Favorable agreement between cal-

culated neutron doses and measured data was found for a typical PWR. Among conclusions reached are that (1) neutrons with energies greater than 0.8 MeV in the annular region at the pressure vessel head flange elevation do not contribute significantly to the dose rates above the operating floor, and (2) gamma rays emanating from the reactor cavity do not constitute a significant contribution to the gamma ray dose rates on the operating floor.

42892 (ORNL/RSIC—43, pp 54-67) **Methodology for the analysis and design of a PWR reactor cavity shield system.** Celnik, J. Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Analysis procedures are described which were used to design a reactor cavity shield system, permitting access to the operating floor in the containment building of a PWR. The design features a stepped upper reactor cavity shield plug with a boron carbide liner and an air gap for cooling the primary concrete shield. Pressure relief is provided by four large 5′ x 6′ multi-legged downvent tunnels. These tunnels are capped by hinged panels of 4 1/2″ Ricorad and 1 1/4″ steel which are designed to open upon a pressure differential of 1/2 lb/in^2.

42893 (ORNL/RSIC—43, pp 76-109) **Reactor cavity streaming: the problem and engineered solutions.** Iotti, R.C. (Ebasco Services Inc., New York, NY); Yang, T.L.; Rogers, W.H. Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Experience at operating pressurized water reactors has revealed that air gaps between the reactor vessel and the biological shield wall can provide paths for radiation streaming, which may prohibitively limit the accessibility required to areas in the containment during power operation, increase personnel exposure during shutdown, and cause radiation damage to equipment and cables located above the vessel. Several concepts of shield are discussed together with their predicted effectiveness. The analytical methods employed to determine the streaming magnitude and the shield effectiveness are also discussed and their accuracy is measured by comparison with actual measurement at an operating plant.

42894 (ORNL/RSIC—43, pp 110-113) **Measured distribution of neutrons inside containment of a PWR.** Butler, H.M.; Ohnesorge, W.F.; Auxier, J.A. (Oak Ridge National Lab., TN). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Fast neutron dose rates inside the containment shell of an operating pressurized water reactor were measured, using threshold detectors. The threshold detector system aso provided crude spectral results. Results indicated a highly moderated spectrum and dose rates that ranged from 0.30 to 394 Rem/hr.

42895 (ORNL/RSIC—43, pp 114-126) **Survey of neutrons inside the containment of a pressurized water reactor.** Hankins, D.E.; Griffith, R.V. (Univ. of California, Livermore). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

A neutron survey was made inside the containment of the Farley Nuclear Plant, Alabama Power and Light Company, Dothan, Alabama, in November 1977. The survey was made to determine the spectra of leakage neutrons and to evaluate the accuracy of albedo neutron dosimeters and a 9-in.-dia sphere rem meter. The survey also covered variations in the neutron spectra, the ratio of gamma-to-neutron dose rates, and the thermal neutron component of the neutron dose.

42896 (ORNL/RSIC—43, pp 127-136) **Calculations of the neutron environment inside a PWR containment.** Hopkins, W.C. (Bechtel Power Corp., Gaithersburg, MD). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Neutron dose rates inside a PWR containment have been calculated using the DOT-DOMINO-MORSE technique. These dose rates are compared to measurements performed by teams from the Health Physics Division of the Oak Ridge National Laboratory and the Lawrence Livermore Laboratory. A simple method for extrapolating neutron dose rates at the top of the refueling pool to other areas in PWR containments is outlined.

42897 (ORNL/RSIC—43, pp 137-148) **Low pressure drop reactor cavity sheild system.** Klotz, R.J.; Cavanaugh, G.P.; Kassawara, R.P.; McLaughlin, D.G. Pilver, A.B. (Combustion Engineering, Inc., Windsor, CT). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

A reactor cavity neutron streaming shield has been developed, which is permanently mounted in the annulus below the pool seal and above the pressure vessel primary coolant pipes. The shield is composed of an array of pipes so arranged as to provide a barrier to radiation streaming while providing a sufficient vent area to prevent excessive pressure buildup during a LOCA. A streaming shield has been designed for a typical System 80 cavity, which provides the required attenuation and, at the same time, keeps the reaction loads on the reactor vessel within design limits.

42898 (ORNL/RSIC—43, pp 149-162) **Radiation streaming and reactor cavity shield design at TVA PWR plants.** Francis, C.C.; Galbreth, T.M; Zobel, W. (Tennessee Valley Authority, Knoxville, TN). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

As the problems associated with radiation streaming in the reactor cavities of operating pressurized water reactors (PWR's) have been identified, TVA has modified and/or analyzed the reactor cavity shield design at the various PWR plants which we are presently designing or constructing. The design approach is described which is taken at each of TVA's four PWR plants to assure an acceptably low level of radiation streaming up through the reactor cavity annulus that could otherwise result in high radiation levels at the operating floor and various other regions inside the containment.

42899 (ORNL/RSIC—43, pp 163-177) **Radiation shielding for BWR shield wall penetrations.** Gillett, T.C. (C.F. Braun and Co., Alhambra, CA); Warkentin, J.K. Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

Piping penetrations are significant radiation streaming paths through the reactor pressure vessel (RPV) shield wall in a boiling water reactor (BWR). Some typical penetrations have an 86.4 cm dia sleeve with a 32.4 cm dia pipe passing through. For the TVA STRIDE units, designed by C.F. Braun and Co., a design approach has been developed to pack most of the penetrations with a castable refractory shielding material, thereby reducing the gap to a minimum. The recirculation outlet line utilizes a flow diverter design. Further shields attached to the pipe are not required. Four penetration calculations were performed with a Monte Carlo analytical technique - the core spray, reactor water level, recirculation inlet, and recirculation outlet penetrations. To improve the statistics and maintain reasonable cost, a stepwise procedure was developed. Statistical analyses were also performed.

42900 **Nozzle seal.** Groff, R.D.; Vatovec, R.J. (to Dept. of Energy). US Patent 4,100,019. 11 Jul 1978. Filed date 27 Jun 1975. 6p.

PAT-APPL-591,255.

In an illustrative embodiment of the invention, a nuclear reactor pressure vessel, having an internal hoop from which the heated coolant emerges from the reactor core and passes through to the reactor outlet nozzles, is provided with annular sealing members operatively disposed between the outlet nozzle and the hoop and partly within a retaining annulus formed in the hoop. The sealing members are biased against the pressure vessel and the hoop and one of the sealing members is provided with a piston type pressure ring sealing member which effectively closes the path between the inlet and outlet coolants in the region about the outlet nozzle establishing a leak-proof condition. Furthermore, the flexible responsiveness of the seal assures that the seal will not structurally couple the hoop to the pressure vessel.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 43002, 43054, 43055, 43075, 43402, 43407

42901 (BNL-NUREG—25715) **Failure mechanisms in high temperature gas cooled reactor fuel particles.** Soo, P.; Uneberg, G.; Sabatini, R.L.; Schweitzer, D.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790625—3). Dep. NTIS, PC A02/MF A01.

From 14. carbon conference; University Park, PA, USA (25 Jun 1979).

BISO coated UO_2 and ThO_2 particles were heated to high temperatures to determine failure mechanisms during hypothetical

loss of coolant scenarios. Rapid failure begins when the oxides are reduced to liquid carbides. Several failure mechanisms are applicable, ranging from hole and crack formation in the coatings to catastrophic particle disintegration.

42902 (BNL-NUREG—25717) **Sublimation phenomena in H451 graphite.** Soo, P.; Shroy, R.E.; Rocks, B.; Schweitzer, D.G.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Buffalo (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790625—4). Dep. NTIS, PC A02/MF A01.

From 14. carbon conference; University Park, PA, USA (25 Jun 1979).

H451 graphite was sublimed and impurity migration and sublimation behavior examined with a proton microprobe analyzer. Impurities migrate down thermal gradients during heating and are released at free surfaces. They are deposited on cooler surfaces and may form compounds. Sublimed graphite also deposits in cooler regions forming a hard graphitic mass.

42903 (GA-A—15188) **Simplified inelastic analysis in helical coil heat exchanger design.** Richard, C.E. (General Atomic Co., San Diego, CA (USA)). Nov 1978. Contract EY-76-C-03-0167-065. 7p. (CONF-790615—5). Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

A simplified, inelastic analysis of helical coil tubing for high-temperature applications is described. Elastically calculated operating stresses are compared with inelastic estimates of allowable cyclic creep/fatigue stresses. The technique of simplifying and analyzing the operating cycles to determine acceptable creep damage levels has general application. The allowable stresses represent the greatest uncertainty in the method, and tests are required to improve their accuracy. A method of utilizing short-time test data to determine allowable stresses for reactor lifetimes of 30 to 40 years is proposed.

42904 (ORNL/TM—6606) **Plan for development of an optimized PCRV for an HTGR power plant.** Gotschall, H.L.; Roberts, J.E.; Callahan, J.P. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

A plan is presented for the development of an optimized prestressed concrete reactor vessel (PCRV) for the steam-cycle high-temperature gas-cooled reactor (HTGR-SC) 900-MW(e) reference plant. The purpose of the proposed program is to identify desirable construction innovations and cost-effective changes in configuration, materials, and design criteria in order to provide the basis for the evolution of more economical plants. It is proposed that such a study be conducted by the potential gas-cooled reactor vendor, an architectural-engineering firm, and a national laboratory, all having experience in the various aspects of PCRV design and development. The scope of the proposed program is outlined, and the tasks to be undertaken during the initial year are discussed together with the estimated first-year costs.

42905 Gidrodinamika i teploobmen v vysokotemperaturnykh yadernykh reaktorakh s sharovymi tvelami. (Hydrodynamics and heat exchange in high temperature nuclear reactors with spherical fuel elements). Bogoyavlenskii, R.G. Moscow, USSR; Atomizdat (1978). 112p.

The book is concerned with the hydrodynamics and heat exchange that occur during the designing and operation of high-temperature gas-cooled thermal and fast neutron nuclear reactors with spherical macro- and micro-fuel elements. A physical model is suggested for the flow of a gas coolant through various placements of spherical fuel elements and micro-fuel elements in non-channel and channel active zones. An analysis is made of the structure of the spherical cells and the connection between the parameters and the volumetric porosity. A theoretical computation is made of the jet resistance factor in a spherical cell. Also given are the method and experimental results on hydrodynamic resistance, the average and local thermal emission factors during gas flow through various placements of spherical fuel elements. The criterial relationships of the resistance and heat exchange factors are used to develop a method for optimal design of spherical fuel element size and the geometric dimensions of the active zones for variable volumetric density of a thermal flow. The suggested method is used to perform a quantitative computation. The book is intended for specialists in the field of nuclear engineering. 45 references, 24 figures, 21 tables.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 43068

42906 Characteristics of plutonium-topped thorium cycles in heavy-water-moderated pressure tube reactors. Banerjee, S. (McMaster Univ., Ontario, Canada); Barclay, F.W. *Nucl. Technol.;* **43**: No. 1, 55-62(Apr 1979).

Thorium cycles in heavy-water-moderated pressure tube reactors are expected to lead to much better nuclear fuel utilization than the current natural uranium once-through fuel cycle. The extent to which various parameters affect fuel cycle economics and uranium requirements during the approach to equilibrium conditions for first-generation plutonium-topped thorium cycle reactors has been studied. The results are compared with systems in which equilibrium has been achieved to elucidate the significant differences between first- and second-generation thorium cycle reactors.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 42998, 42999, 43000, 43003, 43004, 43006, 43015, 43018, 43019, 43021, 43022, 43025, 43029, 43034, 43035, 43047, 43073, 43076, 43080, 43087, 43088, 43089, 43090, 43097, 43105, 43124, 43407, 43432

42907 (AEEW-R—1183) **Zero-power baiss of fast reactor dosimetry.** Sanders, J.E. (UKAEA, Winfrith. Atomic Energy Establishment). Jun 1978. 18p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Predictions of reaction rates, atomic displacements, and gamma-ray energy deposition in the prototype Fast Reactor are based on cross-section data and calculation methods validated against the results of zero-power experiments. The paper reviews work in Zebra relevant to this dosimetry, including neutron spectrometry, power mapping, foil activations within core heterogeneities, and measurements with thermoluminescent detectors. Comparisons of experiment and calculation are discussed in relation to the accuracies required to meet materials testing objectives.

42908 (CONF-790306—16) **Performance of U—Pu—Zr metal fuel in 1000 MWe LMFBRs.** Lam, P.S.K.; Turski, R.B.; Barthold, W.P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The present analyses indicate that very conservatively designed U—Pu—Zr metal-fueled 1000 MW(e) LMFBRs have CSDT in the range of 9 to 10 years, with corresponding specific inventories ranging from 2.5 to 3.5 kg/MWe. Doubling times in the range of 8 years are achievable with only minor changes in the fuel pin design or operating conditions.

42909 (CONF-790402—16) **Elastic-plastic-creep analysis of shells.** Pai, D.H. (Foster Wheeler Corp., Livingston, NJ (USA)). 1979. Contract EW-76-C-2395. 23p. Dep. NTIS, PC A02/MF A01.

From Computational methods in nuclear engineering; Williamsburg, VA, USA (23 Apr 1979).

This paper presents the recent experience of a designer/fabricator of nuclear heat transport components in the area of elastic-plastic-creep analysis of shell-like structures. A brief historical perspective is first given to highlight the evolution leading to the present industry practice. The ASME elevated temperature design criteria will be discussed followed by examples of actual computations performed to support the design/analysis and fabrication of a breeder reactor component in which a substantial amount of elastic-plastic-creep analysis was performed. Mathematical challenges encountered by the design analyst in these problems will be highlighted. Developmental needs and future trends will then be given.

42910 (CONF-790535—3) **Evaluation of error bands and confidence limits for thermal measurements in the CFTL bundle.** Childs, K.W.; Sanders, J.P.; Conklin, J.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From 5. GCFR heat transfer specialists meeting; Wurenlingen, Switzerland (14 May 1979).

Surface cladding temperatures for the fuel rod simulators in the Core Flow Test Loop (CFTL) must be inferred from a measurement at a thermocouple junction within the rod. This step requires the evaluation of the thermal field within the rod based on known parameters such as heat generation rate, dimensional tolerances, thermal properties, and contact coefficients. Uncertainties in the surface temperature can be evaluated by assigning error bands to each of the parameters used in the calculation. A statistical method has been employed to establish the confidence limits for the surface temperature from a combination of the standard deviations of the important parameters. This method indicates that for a CFTL fuel rod simulator with a total power of 38 kW and a ratio of maximum to average axial power of 1.21, the 95% confidence limit for the calculated surface temperature is +- 45°C at the midpoint of the rod.

42911 (CONF-790615—11) **Structural analysis of the Upper Internals Structure for the Clinch River Breeder Reactor Plant.** Houtman, J.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract EW-76-C-15-2395. 54p. Dep. NTIS, PC A04/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

The Upper Internals Structure (UIS) of the Clinch River Breeder Reactor Plant (CRBRP) provides control of core outlet flow to prevent severe thermal transients from occuring at the reactor vessel and primary heat transport outlet piping, provides instrumentation to monitor core performance, provides support for the control rod drivelines, and provides secondary holddown of the core. All of the structural analysis aspects of assuring the UIS is structurally adequate are presented including simplified and rigorous inelastic analysis methods, elevated temperature criteria, environmental effects on material properties, design techniques, and manufacturing constraints.

42912 (COO—2245-27TR(Rev.1)) **Fabrication details for wire wrapped fuel assembly components.** Bossy, B.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Sep 1978. Contract EY-76-S-02-2245. 64p. Dep. NTIS, PC A04/MF A01. Revised by H. Khan.

Extensive hydraulic testing of simulated LMFBR blanket and fuel assemblies is being carried out under this MIT program. The fabrication of these test assemblies has involved development of manufacturing procedures involving the wire wrapped pins and the flow housing. The procedures are described in detail in the report.

42913 (COO—2245-55TR(Rev.1)) **Turbulent sweeping flow mixing model for wire wrapped LMFBR assemblies.** Chiu, C.; Rohsenow, W.M.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Oct 1978. Contract EY-76-S-02-2245. 69p. Dep. NTIS, PC A04/MF A01.

A physical model is proposed to derive the sweeping flow for LMFBR triangular array wire-wrapped assemblies under the turbulent flow condition. Two correlations are suggested for the sweeping flow through two different types of gaps between subchannels, the gap between the interior subchannels and the gap between the wall subchannels. These two sweeping flow correlations are evolved by calibrating the constants in the proposed model against the available experimental data. Agreement between the correlations and all the experimental data of +- 35% is obtained over the assembly design range of $1.315 > P/D > 1.067$ and $52 > H/D > 4$. Based on these correlations, flow sweeping input parameters for two popular computer codes, i.e., COBRA and SUPERENERGY, are recommended.

42914 (COO—2245-64) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, March 1, 1978—May 31, 1978.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1978. Contract EY-76-S-02-2245. 37p. Dep. NTIS, PC A03/MF A01.

An optical technique has been developed for the measurement of the eddy diffusivity of heat in a transparent flowing medium. The method uses a combination of two established measurement tools: a Mach--Zehnder interferometer for the monitoring of turbulently fluctuating temperature and a Laser Doppler Anemometer (LDA) for the measurement of turbulent velocity fluctuations. The technique is applied to the investigation of flow fields characteristic of the LMFBR outlet plenum. The study is accomplished using air as the working fluid in a small scale Plexiglas test section. Flows are introduced into both the 1/15 scale FFTF outlet plenum and the 3/80 scale CRBR geometry plenum at inlet Reynolds numbers of 22,000.

42915 (GA-A—15175(Rev.)) **Modeling of isotopic fission gas release in the GCFR vented fuel rod.** Chang, K.H.; Labar, M.P.; Campana, R.J. (General Atomic Co., San Diego, CA (USA)). Dec 1978. Contract EY-76-C-03-0167-023. 13p. (CONF-790306—14). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The Gas-Cooled Fast Breeder Reactor (GCFR) utilizes the concept of pressure-equalizing and venting fuel rods, primarily to avoid the possibility of cladding creep collapse due to high external coolant pressure (~ 8.6 MPa). One of the major pressure equalization system development activities is a method for predicting the release and venting of gaseous fission products from the fissioning fuel rod. The gaseous fission product release rate is the rate at which gaseous fission products are released from the solid fuel matrix. The venting rate is the rate at which the released fission gases are vented from the fuel rod. Since some of the fission gas isotopes, such as xenon and krypton, are highly radioactive, the prediction of their release and venting rates is necessary for the design and analysis of the fission product trapping and storage systems. To this end, a considerable amount of information has been generated from irradiation experiments. In parallel with the empirical approach, an analytical model has been developed to permit the calculation of the isotopic fission gas release from the fuel of an operating fuel rod. The method consists of an isotopic fission gas release subroutine, GAREL, based on the diffusion of single gas atoms in a spherical fuel particle and a fuel rod thermomechanical performance analysis, LIFE-3. A summary of the GAREL analysis method and the calibration of the method using data from the GB-10 experiment is presented.

42916 (GA-A—15237) **Gas-cooled fast breeder reactor. Quarterly progress report for the period November 1, 1978—January 31, 1979.** (General Atomic Co., San Diego, CA (USA)). Feb 1979. Contract EY-76-C-03-0167-023. 306p. Dep. NTIS, PC A14/MF A01.

Information is presented concerning core assembly development; pressure equalization system for fuel; core assembly design verification; fuels and material engineering; fuel rod engineering; nuclear analysis and reactor physics; shielding requirements; systems engineering; component development; circulator test facility; plant dynamics; reactor safety and reliability; alternate design study; and GCFR alternate fuel cycles.

42917 (GEFR-SP—149) **Application of core structural design guidelines in conceptual fuel pin design.** Patel, M.R.; Stephen, J.D. (General Electric Co., Sunnyvale, CA (USA)). 14 Mar 1979. Contract EY-76-C-03-0893-031. 10p. (CONF-790615—6). Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

The paper describes an application of the Draft RDT Standards F9-7, -8, and -9 to conceptual design of Fast Breeder Reactor (FBR) fuel pins. The Standards are being developed to provide guidelines for structural analysis and design of the FBR core components which have limited ductility at high fluences and are not addressed by the prevalent codes. The development is guided by a national working group sponsored by the Division of Reactor Researcch and Technology of the Department of Energy. The development program summarized in the paper includes establishment of design margins consistent with the test data and component performance requirements, and application of the design rules in various design activities. The application program insures that the quantities required for proper application of the design rules are available from the analysis methods and test data, and that the use of the same design rules in different analysis tools used at different stages of a component design producees consistent results. This is illustrated in the paper by application of the design rules in the analysis methods developed for conceptual and more detailed designs of an FBR fuel pin.

42918 (HEDL-TME—78-84) **EBR-II spectral parameters, Run 75D.** Long, C.L.; Ulseth, J.A.; Lippincott, E.P.; Graves, N.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1979. Contract EY-76-C-14-2170. 77p. Dep. NTIS, PC A05/MF A01.

A dosimetry flux mapping experiment was performed in the EBR-II reactor during Run 75D. Fission and reaction rate data were analyzed from 54 flux spectral sets, containing up to 18 dosimeters and numerous interspersed Fe gradient wires, located in six subassemblies from Row 2 out through Row 8. The dosimeters were located axially from 70 cm below to 75 cm above reactor midplane. The fission and reaction rate data were used to generate neutron spectra from which r,z matrices of nuclear parameters were generated. The report includes parameter matrices for total flux, flux with E > 0.1 MeV, neutron average energy (E bar), and atom displacement cross section values for stainless steel.

42919 (HEDL-TME—78-90) **Sodium technology progress report, January—March 1978.** Atwood, J.M. (comp.). (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1979. Contract EY-76-C-14-2170. 65p. AT.

This report presents a quarterly summary of progress made at Westinghouse Hanford Company in the areas of LMFBR-related radioactivity control technology and sodium systems technology.

42920 (ND-R—50(R)) **Specification of system - independent sequencing calls for modular code schemes.** Enderby, J.A. (UKAEA Reactor Group, Risley). Oct 1977. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

To permit the writing of program modules which may be used without modification in any modular code scheme, a set of FORTRAN subroutine calls for setting up and communicating with modular code sequences has been defined. These calls, which are presented in the paper, hae been defined so as to be independent of the way in which sequencing is implemented by the modular code scheme.

42921 (NEDO—12668) **Constant extension rate testing for LMFBR steam generator applications.** Indig, M.E. (General Electric

Co., San Jose, CA (USA). Nuclear Energy Div.). May 1977. Contract EY-76-C-03-0893-027. 39p. (CONF-770524—4). Dep. NTIS, MF A01.

From ASTM symposium on fatigue testing of weldments; Toronto, Canada (May 1977).

Portions of document are illegible.

A high-temperature constant extension rate facility was developed to evaluate the stress corrosion resistance of alloys considered for the construction of LMFBR steam generators. The primary concern was stress corrosion that might occur on the water side during steam generator operation in locally faulted caustic environments. Most of the studies were performed at 316°C in 5 or 10% NaOH solutions with 2-1/4 Cr-1 Mo steel and Incoloy-800. With minor modification, the constant extension rate test was converted to a straining electrode test. Experiments conducted by the straining electrode test permitted the study of stress corrosion behavior in the high-temperature caustic solutions over a range of oxidizing potentials. It was found that 2-1/4 Cr-1 Mo steel was extremely resistant to caustic cracking at 316°C in all metallurgical conditions tested by the constant extension rate test and the straining electrode test. A few constant extension rate tests were performed at 232°C in 5 and 10% NaOH. At the lower temperature 2-1/4 Cr-1 Mo failed by intergranular and transgranular stress corrosion. Unlike 2-1/4 Cr-1 Mo, Incoloy-800 was susceptible to caustic cracking at 316°C. The susceptibility depended on the metallurgical condition and to some extent, the oxidizing potential. The cold-worked and Grade 1 conditions exhibited excellent resistance to caustic cracking in the constant extension rate test. However, limited studies in the straining electrode test showed the Grade 1 condition could be readily cracked at anodic oxidizing potentials.

42922 (ORNL/SUB—79/55455/1) **Implementation of the unified plasticity—creep constitutive equations with the finite element method.** Stoneking, J.E.; Baker, A.J.; Levine, D.L.; Soliman, M.O. (Tennessee Univ., Knoxville (USA). Dept. of Engineering Science and Mechanics). 12 Apr 1979. Contract W-7405-ENG-26. 62p. AT.

The implementation of unified plasticity—creep constitutive models into production finite element structural analysis codes requires identification of efficient numerical integration procedures for solution of the resultant, highly nonlinear ordinary differential equation systems. A standard implicit integration algorithm has been embedded within a Newton iteration procedure and evaluated for solution of the unified model applied to an axisymmetric example problem. A computer code was written using the elementary constant-strain triangular finite element. Numerical results indicate the developed procedure is fully capable of solving the sample problem with reasonable numerical efficiency.

42923 (ORNL/TM—6792) **Sodium boiling tests in a 19-pin internally guard heated simulated LMFBR fuel assembly with a six-channel internal blockage: record of experimental data for THORS bundle 3C.** Morris, R.H.; Nelson, W.R.;Clapp, N.E.; Hanus, N.; Fontana, M.H.; Gnadt, P.A.; Montgomery, B.H.; Thornton, R.H.; Wantland, J.L. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 376p. AT.

A recored is presented of experimental data obtained during boiling propagation tests with bundle 3C in the Liquid-Metal Fast Breeder Reactor (LMFBR) Thermal-Hydraulic Out-of-Reactor Safety (THORS) Facility. The objective of these tests was to verify that boiling in the wake of a local blockage will not propagate axially or radially. Bundle 3C consisted of 19 electrically heated pins [fuel pin simulators (FPSs)], having the same configuration and heat flux capability as Fast Flux Test Facility (FFTF) and Clinch River Breeder Reactor (CRBR) fuel, surrounded by 12 heated edge pins installed in a stainless steel duct. A 6.4-mm (0.25-in.) stainless steel plate attached to the central pin blocked the six central channels 381 mm (15.0 in.) downstream from the start of the heated section. The test bundle and the loop were designed to simulate prototypic boundary pressure conditions and downstream heat capacity characteristics.

42924 (RAND/R—2441-ACDA) **Comparison of the capital costs of light water reactor and liquid metal fast breeder reactor power plants.** Mooz, W.E.; Siegel, S. (RAND Corp., Santa Monica, CA (USA)). Feb 1979. 71p. Rand Corp., Santa Monica, CA.

Recent studies by Atomics International, General Electric, and Westinghouse yielded capital cost estimates for a fifth of a kind LMFBR. After adjusting these estimates for plant size and converting them to 1978 dollars, they ranged from $1043 to $1495 per kWe, excluding interest during construction (IDC). These cost estimates were compared in this study with a LWR estimated by GE to cost $900 per kWe, also excluding IDC. Projecting these costs far into the future entails great uncertainty. The principal factors that affect future capital cost ratios between the LMFBR and the LWR are: the initial cost ratio that is assumed for the 1977 design plants; assumptions about changes in scope resulting from the social, political, and regulatory climate; and differential construction times for the two types of plant. The cost ratios are relatively unaffected by the LMFBR deployment schedule and cost learning effects, differential scaling effects, and the LMFBR introduction date.

42925 (WAPD-TM—1187) **MDSFP: a computer program for elastic solution of three dimensional structures by the finite element method (LWBR development program).** Clark, R.M. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Feb 1979. Contract EY-76-C-11-0014. 209p. Dep. NTIS, PC A10/MF A01.

MDSFP solves linear elastic, small deflection, three dimensional structures by the finite element method. The idealized model may consist of a mixture of beam, plate, and shell elements connected at node points. Structure loadings are represented by point or distributed loads, temperature distribution, and support displacements. Stresses are calculated from elastic strains which are calculated from nodal displacements. The program was originally written at the Denver Division of Martin-Marietta Corp. It was extensively modified by Bettis to perform elastic analyses of the stresses in various LWBR core structural components resulting from temperature and hydraulic pressure differences.

42926 (WAPD-TM—1269) **Out-of-pile corrosion of zircaloy fasteners containing non-pickled threads (LWBR Development Program).** Kass, S.; Bost, G.E.; Schwer, E.H.; Stout, J.W. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Feb 1979. Contract EY-76-C-11-0014. 36p. Dep. NTIS, PC A03/MF A01.

The most reliable method for the preparation of Zircaloy surfaces for corrosion exposure includes the chemical removal (pickling) of one to three mils of metal from the surface. It was found that the pickling process would not be practical for LWBR threaded fasteners. The results of an out-of-pile experimental program undertaken to establish the corrosion properties of non-pickled threads on Zircaloy-4 material are presented. Six different machining methods were employed in fabricating the threads. Evaluation of the experimental data indicated that the corrosion varied with the thread machining procedure. The corrosion rate was accelerated a maximium of 3 times the rate for pickled Zircaloy.

42927 (WAPD-TM—1270) **Free-hanging bow measurements of LWBR fuel rods (LWBR Development Program).** Caffarel, A.J.; Chao, T.L.; Zamborsky, G.T. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Mar 1979. Contract EY-76-C-11-0014. 45p. Dep. NTIS, PC A03/MF A01.

Special inspection equipment was developed to ensure that the fuel rods for the Light Water Breeder Reactor met the required straightness criteria. The fuel rods were hung in a vertical position and the free-hanging shape was measured. These data were then used analytically to predict both the forces required to constrain the rods in a grid array and the resultant restrained shape. The development of a computerized system which was used for measuring the free-hanging bow of fuel rods used in the LWBR core is described in this paper.

42928 (WAPD-TM—1285) **Radiological control aspects of the fabrication of the Light Water Breeder Reactor core (LWBR Development Program).** Schultz, B.G. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). May 1979. Contract EY-76-C-11-0014. 62p. Dep. NTIS, PC A04/MF A01.

A description is presented of the radiological control aspects of the fabrication of the Light Water Breeder Reactor (LWBR) core. Included are the radiological control criteria applied for the design and use of fabrication facilities, the controls and limits imposed to minimize radiaion exposure to personnel, and an evaluation of the applied radiological program in meeting the program objectives. The goal of the LWBR program is to develop the technology to breed in light water reactors so that nuclear fuel may be used significantly more efficiently in these reactors. This technology is being developed by designing and fabricating a breeder reactor core, utilizing thoria (ThO_2) and binary thoria—urania (ThO_2-$^{233}UO_2$) fuel, to be operated in the existing pressurized water reactor plant owned by the Department of Energy at Shippingport, Pennsylvania.

42929 (WAPD-TM—1316) **ASBLT: a system of DATATRAN MODULES which process core fuel loading for use in as-built calculations (LWBR Development Program).** Beaudoin, B.R.; Beggs, W.J.; Case, C.R.; Wilczynski, R. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Feb 1979. Contract EY-76-C-11-0014. 131p. Dep. NTIS, PC A07/MF A01.

ASBLT is a computer program consisting of DATATRAN MODULES which was used during the manufacturing phase of LWBR to collect and evaluate as-built data. The program was part of the LWBR fuel rod inspection process and produced sections of module assembly certification reports. ASBLT used fuel pellet, fuel rod and module assembly data to compute core inventories and to supply input to nuclear design programs for as-built core calculations.

42930 (WAPD-TM—1331) **Summary of the fuel rod support system (grids) design for LWBR (LWBR development program).** Rich-

ardson, K.D. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Feb 1979. Contract EY-76-C-11-0014. 140p. Dep. NTIS, PC A07/MF A01.

Design features of the fuel rod support system (grids) for the Light Water Breeder Reactor (LWBR) installed in the Shippingport Atomic Power Station, Shippingport, Pennsylvania, are described. The grids are fabricated from AM-350 stainless steel and provide lateral support of the fuel rods in the three regions (seed, blanket, and reflector) of the reactor. A comparison is made of the LWBR grids, whose cells are arranged in triangular-pitched arrays, with rod support systems employed in commercial light water reactors.

42931 West German perspective on the need for the plutonium-fueled LMFBR. Hennies, H.H.; Jansen, P.; Kessler, G. *Nucl. News;* **22**: No. 8, 69-75(Jun 1979).

The need for the deployment of fast breeder reactors in West Germany is discussed and some of the arguments against deployment are examined. Topics covered include future energy deman, uranium demand in West Germany, world uranium demand, proliferation aspects, weapons use of nuclear materials, amount of sensitive materials in the fuel cycle, and alternative fuel cycles.

42932 Mechanical behavior of honeycomb spot-welded spacer grids irradiated in two fuel rod bundles. Haas, D. (Belgonucleaire, Brussels, Belgium); Van de Velde, J.; Braun, H. *Nucl. Technol.;* **43**: No. 1, 100-108(Apr 1979).

In the Rapsodie-I experiment, two bundles, each containing 34 fast breeder reactor fuel pins, have been irradiated up to a peak burnup of 10.6 at. % and to a peak fast fluence (E > 0.1 MeV) of 6.65×10^{26} n/m^2. One of the main objectives of this experimeent was to evaluate the mechanical behavior of a bundle with spacer grids. Two types of spacer grid designs have been tested: namely, a brazed ferrule grid design and a honeycomb spot-welded grid design. The grid material was in every case niobium-stabilized austenitic stainless steel type W.Nr.1.4981 in the annealed condition. The density and the dimensional measurements carried out on the spacer grids revealed that the geometrical changes in the grids were almost entirely due to material void swelling. In some cases, however, mechanical interactions between grids and wrapper tubes and also between fuel pins and grid cells have been emphasized. These interactions had no detrimental influence on the in-pile bundle behavior. The postirradiation mechanical tests carried out on the honeycomb spacer grids showed that the mechanical properties of the grid cells have not been significantly altered by the irradiation. A decrease of the grid material Young's modulus has been correlated with void swelling. It has beeen concluded that the spacer grids operated satisfactorily despite their severe loading conditions.

42933 Fast breeder: answering the questions why and when. Jones, P.M.S. (United Kingdom Atomic Energy Authority, London, England). *Electr. Rev. (London);* **204**: No. 9, 38-39(2 Mar 1979).

Contrary to the views put forward at a conference at London's Polytechnic of the South Bank last December that a programme of fast breeder reactor building is difficult to justify on economic grounds, the author outlines the reasons why the UKAEA sees the reactor as the correct choice to satisfy future energy demand.

42934 ASME publication 79-PVP-25. (Inelastic analysis of the Upper Internals Structure for the Clinch River Breeder Reactor Plant). Falk, P.T.; Kosanchich, M. Sr. Contract EW-76-C-15-2395. New York, NY; American Society of Mechanical Engineers (1979). 32p. (CONF-790615—3). American Society of Mechanical Engineers, 345 East 47th Street, New York, NY.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Inelastic analysis is required for the Upper Internals Structure (UIS) of the Clinch River Breeder Reactor due to its operation in an elevated temperature environment where creep effects are significant. The UIS is a permanent reactor structure and is thus designed to survive in this environment for a 30-year design life. The rigorous inelastic finite element analyses of the critical lower plate ligament are presented. The interaction between the gross model, plate model and ligament model is also described. The analysis results are evaluated temperature design codes required to demonstrate the structural adequacy of the design. The transient conditions, the environmental effects on mechanical properties, elevated temperature analysis guidelines, and the simplified analysis techniques used in determining the critical areas are described.

42935 Magnetic nuclear core restraint and control. Cooper, M.H. (to Dept. of Energy). US Patent 4,131,510. 26 Dec 1978. Filed date 21 Jun 1977. 6p.

Disclosed is a lateral restraint and control system for a nuclear reactor core adaptable to provide an inherent decrease of core reactivity in response to abnormally high reactor coolant fluid temperatures. An electromagnet is associated with structure for radially compressing the core during normal reactor conditions. A portion of the structures forming a magnetic circuit are composed of ferromagnetic material having a curie temperature corresponding to a selected coolant fluid temperature. Upon a selected signal, or inherently upon a preselected rise in coolant temperature, the magnetic force is decreased a given amount sufficient to relieve the compression force so as to allow core radial expansion. The expanded core configuration provides a decreased reactivity, tending to shut down the nuclear reaction.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 42942, 43045, 43047, 43048

42936 (NUREG—0020(Vol.3)(No.4)) **Licensed operating reactors. Operating units status report, data as of 3-31-79.** (Nuclear Regulatory Commission, Washington, DC (USA)). Apr 1979. 189p. NTIS $10.00.

This report is divided into three sections: the first contains monthly highlights and statistics for commercial U.S. operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices and IE Headquarters; and the third section is an appendix containing comparative statistics of U.S. nuclear/fossil capacity, identification of nuclear power plants within regional Electric Reliability Councils, the relative status of U.S. nuclear electric production to all U.S. electric production by state, and selected Edison Electric Institute operating statistics.

42937 (NUREG—0540(Vol.1)(No.1)) **Title list of documents made publicly available, January 1—31, 1979.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). 1979. 304p. Dep. NTIS, PC A14/MF A01.

This document is a monthly publication containing descriptions of information received and generated by the U.S. NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. It is indexed by a Personal Author Index, Corporate Source Index and Report Number Index.

42938 (ORNL/NSP—78/13) **Nuclear standards program. Annual report for calendar year 1978.** (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 7p. AT.

This report presents a summary of the activities and accomplishments of the Nuclear Standards Program during the calendar year 1978. The activities of the ORNL Standards Writer organization are included in this report because they are essentially performed by the staff of the Nuclear Standards Office (NSO) in a dual capacity.

42939 (RDT-INDEX—(4-79)) **RDT Standards Index.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Apr 1979. Contract W-7405-ENG-26. 38p. RSO.

The April 1979 Index of RDT Standards for the period January through March 1979 is presented. The New Publications List identifies each standard, amendment, and/or revision that was published during this period.

42940 (REG/G—704-5) **Functional specification for safety-related valve assemblies in nuclear power plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development). Feb 1979. 16p. NUREG.

The Draft Regulatory Guide describes a method acceptable to the NRC staff for complying with those requirements of Section III, Design Control, of Appendix B to 10 CFR Part 50 relating to the correct translation into specifications for valve assemblies whose operability must be assured.

REACTOR DOCKETS

42941 (NUREG—0540(Vol.1)(No.2)) **Title list of documents made publicly available, February 1—28, 1979.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). 1979. 236p. NTIS, PC A11/MF A01.

This monthly publication contains descriptions of the information received and generated by the U.S. Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. [As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records]. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information includes the information formerly issued through the Department of Energy's Technical Information Center under the title

Power Reactor Docket Information (PRDI) and, in addition, information received or generated on other uses of radioactive materials. (RWR)

ECONOMICS

42942 (MIT-EL—78-009) **Effects of environmental protection and public safety regulatory practices upon light water reactor economics.** Golay, M.W.; Saragossi, I.I. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1978. Contract EY-76-S-02-4119. 184p. Dep. NTIS, PC A09/MF A01.

Thesis.

While there is a consensus regarding the need for extensive regulation of the nuclear power industry, the regulatory process has been the subject of almost constant controversy during recent years. Those subject to regulation complain that regulation is inefficient, that it causes unnecessary licensing and construction delays, and costs; the opponents of nuclear power charge that regulation is inadequate. This study is an effort to evaluate the performance of the regulatory process to which nuclear power plants are subject. The study is subdivided into three parts. Part One presents an analysis of the effects of regulation upon the leadtime and costs of nuclear power plants in the United States. Licensing and construction delays and power plant cost increases caused by regulatory decisions during the past decade are evaluated. Part Two is a brief review of the evolving differences between nuclear power plants and its main rival for base load generation, coal-fired plants, from the viewpoint of the clectric utility planners. Finally, in Part Three, the fundamental problems of the current regulatory process are assessed, and suggestions regarding how to address these problems are presented.

FUEL CYCLE

REFER ALSO TO CITATION(S) 42848, 42931

42943 (EPRI-NP—985) **Sensitivity of nuclear fuel cycle cost to uncertainties in nuclear data.** Becker, M.; Harris, D.R. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Feb 1979. 87p. Electric Power Research Inst., Palo Alto, CA.

A sensitivity analysis system has been developed in order to evalute the economic implications of uncertainties in nuclear data and related computational methods for light water reactors. The relationship between the fuel cycle cost sensitivity and uncertainties in nuclear data and methods is considered to be separable into two consecutive steps referred to as Path A and Path B. Path B determines the sensitivity of the fuel cycle cost to uncertainties in few-group, cell-averaged, microscopic cross sections. Path A relates the latter to uncertainties in the basic nuclear data and computational methods.

42944 (GA-A—15272) **International symbiosis: the role of thorium and the breeders.** Ligon, D.M.; Brogli, R.H. (General Atomic Co., San Diego, CA (USA)). Feb 1979. Contract EY-76-C-03-0167-065. 34p. Dep. NTIS, PC A03/MF A01.

A strategy is presented for meeting nuclear energy requirements through international cooperation and establishment of multinational fuel cycle centers situated in nations with advanced nuclear technologies. The economic feasibility of an international symbiotic nuclear system, based on the concept of comprehensive energy parks, is examined as one approach to meet global energy needs. The system relies heavily on the utilization of breeders as U-233 fuel factories and advanced converters as U-233 consumers. This combination provides attractive proliferation resistance by the operation of a relatively small number of reactors fueled with potential weapons material inside secured areas.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

42945 (ORNL/RSIC—43, pp 68-75) **Improved streaming analysis technique: spherical harmonics expansion of albedo data.** Albert, T.E.; Simmons, G.L. (Science Applications, Inc., La Jolla, CA). Feb 1979.

From 1978 winter meeting of American Nuclear Society; Washington, DC, USA (12 Nov 1978).

An improved albedo scattering technique was implemented with a three-dimensional Monte Carlo transport code for use in analyzing radiation streaming problems. The improvement was based on a shifted spherical Harmonics expansion of the doubly differential albedo data base. The result of the improvement was a factor of 3 to 10 reduction in data storage requirements and approximately a factor of 3 to 6 increase in computational speed. Comparisons of results obtained using the technique with measurements are shown for neutron streaming in one- and two-legged square concrete ducts.

42946 **Burnup-dependent heat transfer from fuel to cladding in fast reactor fuel rods.** Elbel, H. (Kernforschungszentrum, Karlsruhe, Germany); Jimenez, J.L. *Nucl. Technol.;* **43**: No. 1, 88-99(Apr 1979).

The heat transfer coefficient of the interface between the fuel and the cladding of fast reactor fuel rods with different burnups was derived through the analysis of the structure of the UO_2—PuO_2 fuel. A decrease of the heat transfer with increasing burnup was found, resulting in rising fuel surface temperatures. The predictions of a theoretical heat transfer model agreed well with the experimental result. The deterioration of the heat transfer could be explained by fission gas release into the residual gap between fuel and cladding. Heat transfer through contact spots played a negligible role due to low contact pressure and very early formation of an oxide layer on the cladding.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 43423, 43623, 43782

42947 (NUREG/CR—0660) **Enhancement of on-site emergency diesel generator reliability.** Boner, G.L.; Hanners, H.W. (Dayton Univ., OH (USA). Research Inst.). Jan 1979. 262p. (UDR-TR—79-07). NTIS, PC A12/MF A01.

The University of Dayton Research Institute has concluded a program designed to provide NRC/DOR with technical assistance in evaluating the factors leading to improved reliability of on-site emergency diesel generator (DG) units. The program consisted of a comprehensive review of DG maintenance and operating experience and a comparative evaluation of the DG manufacturer's recommendations. This information, will enable the NRC to improve the basis on which it makes regulatory decisions. The primary goal of the program is to better identify the main problem areas which decrease the reliability of the DG units and make recommendations. The report has attained the program objectives by identifying and discussing the more significant problems and presenting the recommended corrective actions. The identified problems have been categorized into three groups as a function of their significance.

42948 (PB—288899) **Development of high-sensitivity ultrasonic techniques for in-service inspection of nuclear reactors. Annual report, 1 October 1976—30 September 1977.** Linzer, M.; Dietz, D.; Parks, S.I. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Research). Oct 1978. 38p.

During the period covered by this report, an ultrasensitive ultrasonic system, incorporating real-time signal averaging, pulse compression, dynamic focusing, and transducer matching, has been developed. The system was shown to be capable of penetrating highly-attenuating material, such as austenitic steel, and of detecting reflections in the presence of strong background signals due to grain scattering.

42949 (SAND—79-0978C) **Comparison of polymer flammabilities and a determination of the loss of fire retardant additives with aging.** Clough, R.L.; Salazar, E.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 9p. (CONF-790632—2). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

An investigation, still in the early stages, on the flammability of two major types of commerical cable insulation formulations that are widely used in nuclear applications is described. The effects of thermal and radiation aging on the combustion properties of these polymeric materials are studied including an evaluation of the potential loss of fire retardant additives. The two polymer types being studied are chlorosulfonated polyethylene (Hypalon) and ethylene-propylene rubber (EPR). The fire retardant system used commercially with both of these polymers consists of two components: antimony trioxide and a chlorinated hydrocarbon.

42950 **Count-doubling time safety circuit.** Rusch, G.K.; Keefe, D.J.; McDowell, W.P. (to Dept. of Energy). US Patent Application 918,259. 23 Jun 1978. 7p.

There is provided a nuclear reactor count-factor-increase time monitoring circuit which includes a pulse-type neutron detector, and means for counting the number of detected pulses during specific time periods. Counts are compared and the comparison is utilized to develop a reactor scram signal, if necessary.

42951 **Significance of reheat cracks to the integrity of pressure vessels for light-water reactors.** Canonico, D.A. (Oak Ridge National

Lab., TN). Contract W-7405-ENG-26. *Weld. J. (Miami);* 58: No. 5, 127s-142s(May 1979).

From 60th AWS Annual Meeting; Detroit, MI (2 Apr 1979).

Reheat cracks manifest themselves as macroscopic defects detectable by nondestructive testing (NDT) procedures or as microscopic grain boundary decohesions (GBD) that are beyond the limit of detection by NDT. The significance of the microscopic cracks that may go undetected are discussed. The probability that GBD exist in the heat-affected zones (HAZ) of weldments of pressure vessel steels is high; particularly in SA508 Class 2 weldments. GBD reside in the coarse-grained region of the HAZ. The microstructure of this region tends to be a tempered martensite or lower bainite, a structure whose fracture toughness is superior to that of a higher temperature transformation product. This region should be less sensitive to irradiation embrittlement. Toughness data for this region in either the unirradiated or irradiated condition are sparse; however, those data that are available indicate that this area is superior in toughness to the base metal. A sample of the HAZ from the prolongation-weldment from the Heavy Section Steel Technology program Intermediate Test Vessel (ITV) No. 4 was examined by the Staatliche Materialpruefungsanstalt (MPA). They reported GBD 5 mm (0.2 in.) long. This prompted an examination of the HAZ from the ITV vessel that had been tested to failure at 24 C (75 F). During testing, the region of the weld which contained the flaw that initiated the failure was strained up to 0.5%. A metallographic examination of this region of the weldment revealed GBD, but none of the size reported by the MPA. Further, there was no evidence that the GBD had extended as a consequence of the tests. Fracture toughness tests were made of the HAZ of welds from ITV-4. The electron-beam welding procedure, which permits more accurate siting of the crack, was used. Fracture toughness values in excess of 220 MPa/m (200 ksi/in.) were obtained at -18 C (O F).

42952 Radiography plays key role in inspecting nuclear castings. *Met. Prog.;* 115: No. 5, 21, 24, 26, 28(May 1979).

The use of a Linatron 2000 linear accelerator for the radiographic inspection of cast valve body pump cases, and elbows for nuclear service is described.

42953 Environment control system. Sammarone, D.G. (to Dept. of Energy). US Patent 4,129,476. 12 Dec 1978. Filed date 28 Jul 1976. 12p.

PAT-APPL-709,473.

Disclosed is a system for controlling the environment of an enclosed area in nuclear reactor installations. The system permits the changing of the environment from nitrogen to air, or from air to nitrogen, without the release of any radioactivity or process gas to the outside atmosphere.

42954 Corrosion monitoring apparatus. Isaacs, H.S.; Weeks, J.R. (to Dept. of Energy). US Patent Application 916,614. 19 Jun 1978. 16p.

Disclosed is a corrosion moniroting device in an aqueous system which includes a formed crevice and monitoring the corrosion of the surfaces forming the crevice by the use of an a-c electrical signal.

42955 Nonlinear transient analysis of nuclear steam generators. Crump, M.W. Ann Arbor, MI; Univ. of Michigan (1978). 252p. University Microfilms Order No. 7907056.

Thesis (Ph. D.).

This paper describes the development and practical application of a numerical modeling method for dynamic thermal and hydraulic analysis of nuclear steam generators. The mathematical model for fluid flows is based upon one-dimensional, nonlinear, single-fluid conservation equations for mass, momentum, and energy. An empirical slip flow model is included in the fluid model to enable description of two-phase slip or homogeneous flows as well as single-phase flows. Space and time discretization of the fluid equations is accomplished using an implicit continuous-fluid Eulerian (ICE) finite-difference formulation. We extend the equation-of-state used in the basic ICE method to a form which is dependent on energy, as well as on pressure and density. The extended ICE method, designated the EICE method, is applicable for calculations of fluid transients in which both fluid compressibility and thermal expansion effects are important. Numerical results are presented for various transient cases based upon steam generator performance or test data. These cases include step reductions in steam and feedwater flow rates, turbine trip, natural circulation flow oscillations, and vessel blowdown transients. The comparison of numerical results with test data indicates a good prediction of the thermal and hydraulic behavior of the systems. Furthermore, the EICE method is seen to maintain good numerical stability and spatial continuity characteristics throughout these calculations.

42956 Linearized transient analysis of nuclear steam generators. Van Tuyle, G.J. Ann Arbor, MI; Univ. of Michigan (1978). 212p. University Microfilms Order No. 7907191.

Thesis (Ph. D.).

This paper describes the development and application of a computer model simulating the transient behavior of nuclear steam generators. The effort was directed primarily toward development of a simplified linearized model for integral-economizer once-through steam generators. The model utilizes a moveable boundary spatial discretization technique, and is capable of representing the transient behavior in time-domain, and providing frequency-domain analysis. Notable features of the model include full treatment of a time-independent momentum equation, as well as a perturbation technique used to evaluate the dependence of heat flux and pressure gradient on other system properties. Additionally, a sophisticated perturbation technique was developed that provides constraint equations for moving boundaries between heat transfer regions. A detailed steady-state model was developed to provide initial values for the transient calculators. This steady-state model includes a flexible boundary search algorithm, and a scaling capability for subdivision of large heat transfer regions so as to provide more accurate representation of internal distribution. An enthalpy transport model was developed to improve representation of the in-cell distribution of enthalpy under transient conditions. Results from the model were verified against experimental data from a 19-tube test facility, and against results obtained using the fixed-mesh, nonlinear formulation of the TRANSG code.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 43064

42957 (HEDL-SA—1746-FP) **Controlled biaxial strain-rate test results from unirradiated 20% CW 316 stainless steel cladding at constant temperature.** Cannon, N.S. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 10p. (CONF-790219—8). Dep. NTIS, PC A02/MF A01.

From AIME annual meeting; New Orleans, LA, USA (18 Feb 1979).

Constant temperature controlled biaxial strain-rate (CBSR) tests were performed on unirradiated 20% CW 316 stainless steel reactor cladding. Tests were made at hoop strain-rates of 1.2×10^{-5}/s, 1.2×10^{-4}/s, 6×10^{-4}/s, and 1.2×10^{-3}/s. For each of these strain rates, tests were performed at 425°C, 540°C, and 650°C. The data from these tests are examined and compared with previously reported tensile data. A simple relationship between tensile and CBSR tests is developed, allowing easy correlation of the CBSR results.

CONTROL SYSTEMS

42958 Osnovy proektirovaniya mekhanizmov upravleniya yadernykh reaktorov. (Design principles for the control mechanisms of nuclear reactors). Emel'yanov, I.Ya.; Voskoboinikov, V.V.; Maslenok, B.A. Moscow, USSR; Atomizdat (1978). 272p.

An examination is made of problems in the designing of mechanisms for control of nculear reactors, and future trends and prospects are indicated for the automation of energy installations. A summarization and systematic analysis is made of domestic and foreign experience in the design, finishing, and operation of reactor protection control systems. A description is given of control systems of nuclear electric power plants and the optimal designs of control mechanisms and their individual parts. Methods are given for their computations. Particular attention is given to future trends in the development of control mechanisms, and particularly discrete electromagnetic protection control system drives. An examination is made of problems in the reliability, economic efficiency, and engineering design. The book is intended for engineers and technicians engaged in the design and operation of control mechanisms. It may also be used by students at institutions of higher learning. 170 references, 140 figures, 21 tables.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 42849

42959 (EPA/600/9—78-013, pp 46p, EEED 104) **Fuel cycle for 1000-Mw uranium—plutonium fueled water reactor.** Pigford, T.H.; Cantrell, R.T.; Ang, K.P. (Univ. of California, Berkeley). Jun 1978.

In Comprehensive standards: the power generation case.

An illustrative data base is presented of material quantities and environmental effluents in the fuel cycle for a light-water nuclear reactor fueled entirely with plutonium and natural uranium. Data were calculated for a 1000 Mw nuclear power plant operating

on an equilibrium fuel cycle. Results are shown in tables and on a fuel-cycle flowsheet.

42960 (EPA/600/9—78-013, pp 62p, EEED 105) **Fuel cycle for 1000-Mw high-temperature gas-cooled reactor.** Pigford, T.H. (Univ. of California, Berkeley); Cantrell, R.T.; Ang, K.P.; Mann, B.J. Jun 1978.

In Comprehensive standards: the power generation case.

An illustrative data base is presented of material quantities and environmental effluents in the fuel cycle for a high-temperature gas-cooled reactor fueled with uranium and thorium. Data were calculated for a 1000 Mw nuclear power plant operating on an equilibrium fuel cycle. Results are shown in tables and on a fuel-cycle flowsheet.

42961 (NUREG/CR—0819) **Numerical modeling of entrainment and far field thermal dispersion for NEP 1 and 2, Charlestown, Rhode Island.** Isaji, T.; Spaulding, M. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 462p. (ORNL/NUREG/TM—325). Dep. NTIS, PC A20/MF A01.

A system of numerical models was developed which assessed the larvae entrainment into the intake and the far field thermal dispersion due to the cooling system operation of the proposed nuclear power plant NEP 1 and 2, Charlestown, Rhode Island. The hydrodynamics was simulated by a two dimensional, vertically averaged, finite element hydrodynamic model. The entrainment of winter flounder larvae was simulated by the finite element constituent transport model and the particle path model. The models predicted an entrainment of 4.7% under the proposed intake and diffuser operation. The diffuser return flow enhanced the entrainment by 20% compared with the intake operation only. The far field thermal dispersion for the proposed heat discharge system was simulated with different conditions and parameters. Significant factors among the different conditions to be estimated were found to be the mixed layer depth and diffusion coefficient. The most probable case was simulated. The isotherm areas were 5609 acres for 1.0°C (1.8°F) and 1804 acres for 3.0°C (5.4°F).

SITING

REFER ALSO TO CITATION(S) 43205

42962 (CONF-790445—4) **Comparison of the socioeconomic impacts of international fuel service centers versus dispersed nuclear facilities.** Braid, R.B. Jr. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 21p. Dep. NTIS, MF A01.

From 19. annual meeting of the institute of environmental sciences; Seattle, WA, USA (29 Apr 1979).

Portions of document are illegible.

The paper investigates a variety of community impacts including: public services, fiscal issues, economic matters, land and water use, political and social cohesion, and legal considerations. Comparisons of socioeconomic impacts of colocated versus dispersed sites are made on the basis of the size of the impacted communities, the size and type of nuclear facility, and the facility's construction time frame. The paper concludes that, under similar circumstances, most of the socioeconomic impacts of colocated nuclear facilities would be somewhat less than the sum of the impacts associated with equivalent dispersed sites. While empirical data is non-existent, the paper contends, however, that because the socioeconomic impacts of colocated facilities are so great and readily identifiable to a public unskilled in making comparisons with the dispersed alternative, the facilities will likely generate so much public opposition that IFSCs will probably prove infeasible.

42963 (GA-A—15067) **SOILST: a computer program for soil-structure interaction analysis.** Johnson, J.J. (General Atomic Co., San Diego, CA (USA)). Apr 1979. Contract EY-76-C-03-0167-065. 150p. Dep. NTIS, PC A07/MF A01.

SOILST is a computer program to perform soil-structure interaction analysis. Two types of analysis can be performed: time history analysis by direct integration, and the determination of equivalent modal damping ratios for the coupled soil-structure system. The super-structure dynamic characteristics are defined by the structure's fixed-base eigensystem. The behavior of the supporting soil is defined by frequency independent impedance functions. The theory, user's manual, and listing of the program are presented.

42964 **Probabilistic prediction of X/Q for routine intermittent gaseous releases: a model comparison.** Woodard, K. (Pickard, Lowe and Garrick, Inc., Washington, DC); Potter, T.; Kaplan, S. pp III.5.1-III.5.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper describes a technique for determining the probability of exceeding a given atmospheric dispersion factor (X/Q) during intermittent releases of radioactive materials from a nuclear plant. A convolution technique is used to estimate a probability distribution for X/Q averaged over n releases based on the X/Q distribution for a single release. Results showed that X/Q values obtained using the current NRC technique have a very low probability of occurrence for the three sites studied. Additionally, it was found that average annual X/Q determined using the Regulatory Guide 1.111 model was adequate for calculating doses due to intermittent releases.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 43067, 43759, 43763, 43773

42965 (BNL—25641) **HFBR computer controlled stack monitoring facility.** Distenfeld, C. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790602—43). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The Brookhaven High Flux Beam Research Reactor (HFBR) has been operating at a nominal power of 40 MW since 1965. Modifications are nearing completion to increase the power level to 60 MW. The power increase provided the impetus to review and subsequently improve all aspects of stack and meteorological monitoring, data processing, and readout.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 42961, 43782, 43784, 43840

42966 (UCID—17744-79-1) **Chemical effluents in surface waters from nuclear power plants. Quarterly progress report.** Harrison, F.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jan 1979. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

Field collections were initiated in October, 1978, at the Salem and Surry Power Stations. Copper concentrations in soluble and particulate fractions of the water and in bedload sediments were similar to those measured earlier in samples from several power stations at fresh water sites, but higher than those from marine stations. Polarographic analyses of filtered influent and effluent waters indicate that little or no copper was labile. According to ultrafiltration studies, a significant fraction of the copper in water from both sites was complexed to organic matter. Distribution coefficients determined with ^{64}Cu were higher for suspended particles in the water column than for bedload sediments from the intake and discharge areas.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 42473, 42919, 43005, 43007, 43016, 43023, 43028, 43074

42967 (ANL—79-5) **Monte Carlo-based validation of the ENDF/MC²-II/SDX cell homogenization path.** Wade, D.C. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 64p. Dep. NTIS, PC A04/MF A01.

The results are presented of a program of validation of the unit cell homogenization prescriptions and codes used for the analysis of Zero Power Reactor (ZPR) fast breeder reactor critical experiments. The ZPR drawer loading patterns comprise both plate type and pin-calandria type unit cells. A prescription is used to convert the three dimensional physical geometry of the drawer loadings into one dimensional calculational models. The ETOE-II/MC²-II/SDX code sequence is used to transform ENDF/B basic nuclear data into unit cell average broad group cross sections based on the 1D models. Cell average, broad group anisotropic diffusion coefficients are generated using the methods of Benoist or of Gelbard. The resulting broad (~ 10 to 30) group parameters are used in multigroup diffusion and S/sub n/ transport calculations of full core XY or RZ models which employ smeared atom densities to represent the contents of the unit cells.

42968 (CONF-790423—9) **Performance of a LOFT drag-disc turbine transducer and gamma densitometer under transient two-phase blowdown conditions.** Nalezny, C.L.; Chen, L.L.; Solbrig, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

One of the basic parameters measured during the LOFT loss-of-coolant experiment (LOCE) is two-phase mass flow rate. The flow measurement transducers used in LOFT were designed to determine the mass flow rates at discrete points in a transient two-phase flow field (free field measurement configuration). These instru-

ments are calibrated in steady state single-phase water (full flow configuration). The single phase calibrations are used with two-phase flow measurement models to compute two-phase mass flow. The paper reports a performance evaluation of LOFT two-phase flow measurement techniques under transient two-phase flow conditions.

42969 (CONF-790423—12) **Performance predictions for a large scale transient two-phase flow test facility.** Nalezny, C.L.; Chapman, R.L.; Martinell, J.S.; Riordan, R.P.; Solbrig, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

The LOFT program uses a sophisticated and complex instrumentation system to measure fluid flow under blowdown conditions. The complicated two-phase flow regimes that exist during the blowdowns necessitate the use of such instrumentation. Several combinations of instruments are used to measure two-phase mass flow rate (i.e., drag disk-turbine, drag disk-gamma densitometer and turbine-gamma densitometer). These instruments only sample discrete points in the cross-section of the pipe, and since there are pipe bends near the instrument locations, there is a tendency for stratification to occur which cannot be accounted for by the instruments. Consequently, there is a great deal of uncertainty as to how well the instruments perform under two-phase flow conditions. It is necessary to check instrument performance under transient flow conditions with the identical instrument and piping configuration in LOFT. The information gained from such tests will be used to evaluate the performance medels used to compute two-phase mass flow rate. This document presents the results of RELAP4 and SAP4 analyses of the tests to be performed in the Wyle Transient Test System. These analyses will be used to define the following: (a) the expected instrument ranges, (b) the predicted transient load cell readings and weighing system measurement error analyses, (c) the expected similarity between blowdowns in the Wyle Transient Test data and LOFT—LOCE data.

42970 (CONF-790602—22) **Fuel rod response during LOFT Test L2-2.** Niebruegge, D.A.; Tolman, E.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The Loss-of-Fluid Test (LOFT) Facility is providing unique data on the response of a nuclear reactor to a loss-of-coolant accident (LOCA). The data are being used to assess the accuracy of the computer codes used in reactor safety analysis. The first LOFT nuclear test, Test L2-2, was a cold leg break LOCA at a peak linear power of 26.25 kW/m. The paper briefly describes the LOFT core, discusses fuel rod response during Test L2-2, and compares the data with the test prediction.

42971 (CONF-790602—24) **LOFT: zero power/power range physics testing measurements versus calculations.** Gill, G.S.; Rushton, B.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The Loss-of-Fluid Test Reactor (LOFT), located at the Idaho National Engineering Laboratory, achieved criticality on Febraury 5, 1978. The zero power and power-range physics testing programs have subsequently been completed. At zero power reactor physics parameters were masured for uniform core conditions ranging from 319 to 556 K, where the temperature conditions were established using primary pump heat without nuclear heat. Power range testing consisted of power escalation to 98% of 50 MW/sub t/. The paper compares the experimental results to those from design calculations. Pertinent details of LOFT, design methods, and comparison results are given.

42972 (HEDL-SA—1537-FP) **Records management at Westinghouse Hanford Company.** Humason, T.O. (Hanford Engineering Development Lab., Richland, WA (USA)). 23 Aug 1978. Contract EY-76-C-14-2170. 24p. (CONF-7810168—1). Dep. NTIS, PC A02/MF A01.

From Association of records managers and administrators annual conference; Washington, DC, USA (8 Oct 1978).

A program for the acquisition, dissemination, storage, and retrieval of documentation associated with the FFTF project is described.

42973 (HEDL-SA—1630) **PMS: What are you getting for your money?.** Rigney, R.A.; Campbell, R.H. (Hanford Engineering Development Lab., Richland, WA (USA); Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management). 27 Sep 1978. Contract EY-76-C-14-2170. 12p. (CONF-7810120—1). Dep. NTIS, MF A01.

From PMI seminar/symposium; Anaheim, CA, USA (7 Oct 1978).

Portions of document are illegible.

The development and effectiveness of a Performance Measurement System (PMS) for contractors at Hanford Engineering Development Laboratory are discussed. The system was developed in particular for the FFTF project but has been extended to other areas.

42974 (HEDL-TC—1329) **LOFT advanced fuel rod instrumentation development. Midyear review.** Sheen, E.M.; Stringer, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 57p. Dep. NTIS, PC A03/MF A01.

Information on fuel rod instrumentation is presented concerning fuel centerline temperature measurement; fuel rod pressure measurement; fuel rod axial motion; and fuel plenum gas temperature.

42975 (HEDL-TME—79-9) **Test data and post-test analyses of three prototypic-length FFTF fuel pins transient tested in flowing sodium (HUT-L2).** Bard, F.E.; Gneiting, B.C.; Horn, W.P.; Houser, T.R.; Manthos, E.J.; Randklev, E.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 180p. AT.

The post-test measurements and the thermal, mechanical, and design procedure analyses of the HUT-L2 transient test are presented. This test was a loop experiment conducted in the TREAT facility. The HEDL MARK-IIC integral sodium loop test vehicle was used to simultaneously test three prototypic-length fresh fuel pins in a simulated FFTF environment. The objectives of the experiment were to obtain measurable cladding deformation and fuel melting for all three fuel pins. Fuel melting occurred in each fuel pin but measurable deformation occurred only in the high smeared density HUT-L2-4 fuel pin.

42976 (LTR—111-104(Rev.A)) **Power range testing core safety analysis.** Atkinson, S.A.; Dimenna, R.A.; Howe, T.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 4 Dec 1978. Contract EY-76-C-07-1570. 267p. Dep. NTIS, PC A12/MF A01.

The core safety analyses are presented for normal LOFT power operation and for the LOFT Power Range tests. This report and the LOFT FSAR, which is the basis for most of this report, provide the core safety analysis for LOFT power ascension and Power Range tests.

42977 (LTR—114-104) **LOFT CIS analysis: 1"-PCC-76-A inside containment penetration S-1A. Internal technical report.** Nitzel, M.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 11 Dec 1978. Contract EY-76-C-07-1570. 270p. (REA-A—78-172). Dep. NTIS, MF A01.

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The stress analysis performed on the 1"-PCC-76-A piping system inside containment penetration S-1A is described. Deadweight, thermal expansion, and seismic loads were considered. Results of this analysis show that the subject piping system will meet ASME Boiler and Pressure Vessel Code, Section III, Class 2 requirements provided that supports S8 and S9 are installed as recommended.

42978 (LTR—123-5) **LOFT CIS analysis S-11A penetration 12" H & V duct.** Barry, W.J. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)). 17 Nov 1978. Contract EY-76-C-07-1570. 68p. Dep. NTIS, PC A04/MF A01.

The 12" H & V duct and related piping outside the LOFT containment connected to containment penetration S-11A was analyzed to ASME Code Subsection NC (Class 2) criteria. This duct is part of the Containment Isolation System and the analytical model considered the duct from the containment O.D. outward through the first and second isolation valves. Results of this analysis show that section of the line will meet Class 2 requirements if a restraint (two directions horizontal and one vertical translation) is installed at the second isolation valve.

42979 (LTR—125-6) **LOFT CIS analysis 8"-WW-172-AB inside penetration S-7A.** Condie, C.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 30 Oct 1978. Contract EY-76-C-07-1570. 78p. (RE-A—78-063). Dep. NTIS, PC A05/MF A01.

Line 8"-WW-172-AB and related piping inside the LOFT containment and connected to penetration S-7A was analyzed to ASME Code, Subsection NC (Class 2) criteria. This piping is part of the Containment Isolation System. The model considered the piping from the containment I.D. inward through the second isolation valve. The analysis shows overstressed areas at the first, fourth, and fifth elbows from the penetration during the Safe Shutdown Earthquake. This stress may be relieved so that the line will meet Class 2 requirements if two restraints are added to the system.

42980 (LTR—136-5) **LOFT CIS analysis S-5B penetration 3" IA-296-AB.** Barry, W.J. Jr. (Idaho National Engineering Lab., Idaho Falls (USA)). 31 Oct 1978. Contract EY-76-C-07-1570. 75p. (RE-A—78-059). Dep. NTIS, PC A04/MF A01.

The 3" IA-296-AB line from the containment penetration S-5B was analyzed to ASME Code, Subsection NC (Class 2) criteria. This section of piping is part of the Containment Isolation System; the model considered the line from penetration S-5B outward through a series of elbows and through the third isolation valve. Results of this analysis show that the section of line described will meet Class 2 requirements if additional supports are installed at three locations.

42981 (LTR—141-101) **Long-term bearing wear tests of conventional journal bearings and development of hydrostatic bearings for the LOFT drag-disc turbine transducer.** Fincke, J.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 22 Mar 1979. Contract EY-76-C-07-1570. 59p. Dep. NTIS, PC A04/MF A01.

The details of a two-year development program concerning materials for use as turbine bearings in a pressurized water reactor environment are reported. Two types of bearings have been examined, both conventional journal bearings and hydrostatic bearings. The results of long-term bearing wear tests conducted at 590 K and 15.1 MPa in water are presented. The feasibility of using hydrostatic bearings for the same transducer is demonstrated.

42982 (LTR—144-8(Suppl.1)) **Stress evaluation of the welded locking cups for the MDTT rake.** Finicle, D.P. (Idaho National Engineering Lab., Idaho Falls (USA)). 23 Jan 1979. Contract EY-76-C-07-1570. 30p. (RE-E—77-130(Suppl.1)). Dep. NTIS, PC A03/MF A01.

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A stress analysis of the LOFT Three MDTT Rake system has been completed. The changes considered from Ref. 2 were the welds on the locking cups and the deletion of the support pads on the outer end of the rake sleeves. These modifications were analyzed to the requirements of Section III of the ASME Code (1977).

42983 (LTR—1334-5) **LOFT CIS analysis - 1" IG-I-58-B inside containment penetration S-9A.** Nitzel, M.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 30 Oct 1978. Contract EY-76-C-07-1570. 59p. (RE-A—78-160). Dep. NTIS, PC A04/MF A01.

The stress analysis performed on the 1"-IG-I-58-B piping system inside containment penetration S-9A is described. Deadweight, thermal expansion, and seismic loads were considered. Results of this analysis show that the subject piping system will meet ASME Boiler and Pressure Vessel Code, Section III, Class 2 requirements provided that an additional support (S3) is installed as recommended.

42984 (ORNL/TM—6894) **Oak Ridge Research Reactor quarterly report October, November and December of 1978.** Hurt, S.S. III; Lance, E.D. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

The ORR operated at an average power level of 29.0 MW for 80.9% of the time during October, November, and December of 1978. The reactor was shut down on fourteen occasions, four of which were unscheduled. Reactor downtime needed for refueling, maintenance and checks was normal, with the reactor remaining available for operation 92.2% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature.

42985 (TREE—1358) **Neutron spectrum measurements in CFRMF ^{6}Li spectrometry.** Deleeuw-Gierts, G.; Rogers, J.W.; Deleeuw S.; Johnson, L.O. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1979. Contract EY-76-C-07-1570. 34p. Dep. NTIS, PC A03/MF A01.

The neutron energy spectrum of the Coupled Fast Reactivity Measurements Facility (CFRMF) has been measured by the ^{6}Li(n,α)t spectrometry technique between the energies of 10 keV and 8 MeV. These measurements were made in order to improve the knowledge of this benchmark neutron field as related to dosimetry and other integral cross sections. Energy spectra of both the α't and t responses were obtained simultaneously using two-parameter multichannel pulse height analyses. Spectrometers of different design and resolution characteristics were applied. The data were reduced using recently evaluated cross section information. The results are compared with the neutron spectrum calculated using recently evaluated cross section information.

42986 (BNWL-tr—329) **Test instrumentation in research reactors.** Friboulet, C.; Gros, D.; Masson, M.; Rousseau, D.; Gentil, J.; Voituriez, B.; Warlop, R. Jun 1978. Translation of PI/SEDTI 220/78. (CONF-7805110—2). 36p. Dep. NTIS, PC A03/MF A01.

From Working group on irradiation devices; Petten, Netherlands (18 May 1978).

The evolution of irradiation programs has led to extensive development of test instrumentation. Typical types of measurements are described.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 43001

42987 (UNI-SA—57) **Improved performance of N reactor through the systems approach.** Leitz, E.E. (United Nuclear Industries, Inc., Richland, WA (USA)). 5 Dec 1978. Contract EY-76-C-06-1857. 29p. (CONF-790443—1). Dep. NTIS, PC A03/MF A01.

From American power conference; Chicago, IL, USA (23 Apr 1979).

A systems approach was applied to the improvement of N Reactor performance in the following areas: fuel element failure, fuel oil consumption in reactor auxiliary systems, and reactor maintenance.

PROPULSION REACTORS

REFER ALSO TO CITATION(S) 43407

REACTOR SAFETY

42988 (CDAP-TR—051) **BEACON/MOD2A: a computer program for subcompartment analysis of nuclear reactor containment. A user's manual.** Wells, R.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1979. Contract EY-76-C-07-1570. 334p. Dep. NTIS, PC A15/MF A01.

The BEACON code is a Best Estimate Advanced Containment code which being developed by EG & G, Idaho, Inc., at the Idaho National Engineering Laboratory. The program is designed to perform a best estimate analysis of the flow of a mixture of air, water, and steam in a nuclear reactor containment system under loss-of-coolant accident conditions. The code can simulate two-component, two-phase fluid flow in complex geometries using a combination of two-dimensional, one-dimensional, and lumped-parameter representations for the various parts of the system. The current version of BEACON, which is designated BEACON/MOD2A, contains mass and heat transfer models for wall film and for wall conduction. It is suitable for the evaluation of short term transients in PWR dry containment systems. This manual describes the models employed in BEACON/MOD2A and specifies code implementation requirements. It provides application information for input data preparation and for output data interpretation.

42989 (CDAP-TR—054) **Heat transfer correlation development and assessment: a summary and assessment of return to nucleate boiling phenomena during blowdown tests conducted at the Idaho National Engineering Laboratory (INEL).** Eaton, A.M.; Tolman, E.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 80p. Dep. NTIS, PC A05/MF A01.

The data are presented which were obtained in Loss-of-Coolant Experiments (LOCE) at Idaho National Engineering Laboratory (INEL) which demonstrate the presence of cladding rewetting after the critical heat flux has been exceeded as a viable cooling mechanism during the blowdown phase of a LOCE. A brief review of the mechanisms associated with the boiling crisis and rewetting is also provided. The relevance of INEL LOCE rewetting data to nuclear reactor licensing Evaluation Model Requirements is considered, and the conclusion is made that the elimination of rewetting and return to nucleate boiling (RNB) in Evaluation Models represents a definite conservatism.

42990 (CONF-781146—14) **NRC/RSR Data Bank Program.** Bankert, S.F.; Evans, C.D.; Hardy, H.A.; Litteer, G.L.; Schulz, G.L.; Smith, N.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 12p. Dep. NTIS, PC A02/MF A01.

From 6. water reactor safety research meeting; Germantown, MD, USA (6 Nov 1978).

The United States Nuclear Regulatory Commission (NRC) has established the NRC/Reactor Safety Research (RSR) Data Bank Program at the Idaho National Engineering Laboratory (INEL). The program provides the means of collecting, storing, and making available experimental data from the many water reactor safety research programs in the United States and other countries. The program collects qualified engineering data on a prioritized basis from experimental program data bases, stores the data in a single data bank in a common format, and makes the data available to users.

42991 (CONF-790423—11) **Heat transfer considerations for the first nuclear blowdowns.** Spore, J.W.; Giles, M.M.; Evans, D.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 9p. Dep. NTIS, PC A02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

The first nuclear blowdowns were carried out in the Power Burst Facility at the Idaho National Engineering Laboratory as the LOC-11 series of experiments. This test series was designed to simulate a blowdown transient in a pressurized water reactor (PWR) so that nuclear fuel performance could be investigated under conditions representative of the PWR 15 x 15 fuel element design. Post-test calculations using the RELAP4 computer program were performed for the LOC-11B and LOC-11C tests. Comparisons between calculations and experimental data revealed that the ability to accurately model (1) critical heat flux (CHF) during low core flow conditions, (2) initial stored energy in the fuel rods, and (3) radiative heat transfer between fuel rods and shrouds, was required to adequately represent the fuel rod thermal behavior. Pre-test calculations performed using RELAP4 with licensing-type heat transfer and fuel rod models resulted in peak cladding temperatures several hundred K higher than measured, thus providing further evidence of the need to accurately model heat transfer and fuel rod behavior.

42992 (CONF-790423—13) **Calculations of flow oscillations during reflood using RELAP4/MOD6.** Chen, Y.S.; Fischer, S.R.; Sullivan, L.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 18p. Dep. NTIS, PC A02/MF A01.

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

RELAP4/MOD6 is an analytical computer code which can be used for best-estimate analysis of LWR reactor system blowdown and reflood response to a postulated LOCA. In this study, flow oscillations in the PKL reflood test K5A were investigated using RELAP4/MOD6. Both calculated and measured oscillations exhibited transient characteristics of density-wave and pressure-drop oscillations. The calculated average core mixture level rising rate agrees closely with the test data. Several mechanisms which appear to be responsible for initiation and continuation of calculated or experimental reflood flow oscillations are (a) the coupling between the vapor generation in the core channel and the U-tube geometrical arrangement of a downcomer and a heated core; (b) the inherent low core inlet resistance and the high system outlet resistance; (c) the dependence of heat transfer rate on mass flow rate especially in the dispersed flow ially in the dispersed flow regime; (d) the amount of the liquid entrainment fraction of the heated core channel.

42993 (CONF-790441—6) **Nuclear fuel rod behavior during LOFT experiment L2-2.** Tolman, E.L.; Niebruegge, D.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From ANS topical meeting on light water reactor fuel performance; Portland, OR, USA (29 Apr 1979).

The Loss-of-Fluid Test (LOFT) reactor is providing data to evaluate analytical models to predict the thermal-hydraulic and fuel rod response of a pressurized water reactor (PWR) under loss-of-coolant accident (LOCA) conditions. The fuel rod response for the first nuclear loss-of-coolant experiment (LOCE), LOCE L2-2, is summarized.

42994 (CONF-790505—9) **Current capabilities of transient two-phase flow instruments.** Solbrig, C.W.; Kondic, N.N. (Idaho National Engineering Lab., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From 25. ISA international instrumentation symposium; Anaheim, CA, USA (7 May 1979).

The measurement of two phase flow phenomena in transient conditions representative of a Loss-of-Coolant Accident requires the use of sophisticated instruments and the further development of other instruments. Measurements made in large size pipes are often flow regime dependent. The flow regimes encountered depend upon the system geometry, transient effects, heat transfer, etc. The geometries in which these measurements must be made, the instruments which are currently used, new instruments being developed, the facilities used to calibrate these instruments, and the improvements which must be made to measurement capabilities are described.

42995 (CONF-790602—13) **Analysis of the General Electric Company swell tests with RELAP4/MOD7.** Fischer, S.R.; Hendrix, C.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The RELAP4/MOD7 nuclear reactor transient analysis code, presently being developed by EG and G Idaho, Inc., will incorporate several significant improvements over earlier versions of RELAP4. As part of the development of RELAP4/MOD7, a thorough assessment of the capability of the code to simulate water reactor LOCA phenomena is being made. This assessment is accomplished in part by comparing results from code calculations with test data from experimental facilities. Simulations of the General Electric Company (GE) level swell tests were performed as part of the code checkout. In these tests, a pressurized vessel partially filled with nearly saturated water was blown down through a simulated break located near the top of the vessel. Comparison of RELAP4 calculations with data from these experiments indicates that the code has the capability to model the unequal phase velocity flow and resulting density gradients that might occur in a BWR steam line break transient. Comparisons of RELAP4 calculations with data from two level swell experiments are presented.

42996 (CONF-790602—21) **Potential for cladding thermal failure in LWRs during high temperature transients.** El Genk, M.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The temperature increase in the fuel and the cladding during a PCM accident produces film boiling at the cladding surface which may induce zircaloy cladding failure, due to embrittlement, and fuel melting at the centerline of the fuel pellets. Molten fuel may extrude through radial cracks in the fuel and relocate in the fuel-cladding gap. Contact of extruded molten fuel with the cladding, which is at high temperature during film boiling, may induce cladding thermal failure due to melting. An assessment of central fuel melting and molten fuel extrusion into the fuel-cladding gap during a PCM accident is presented. The potential for thermal failure of the zircaloy cladding upon being contacted by molten fuel during such an accident is also analyzed and compared with the applicable experimental evidence.

42997 (CONF-790602—23) **Techniques for validating uncertainty analyses in large computer codes .** Peck, S.O. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 3p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The uncertainty in the output of large computer codes provides an important measure of the credibility of the code. In applications where safety is a concern, an accurate assessment of output uncertainty will allow a rational determination of margin. Recent uncertainty analyses of large computer codes have begun to use the response surface method and second order error propagation methods to determine output uncertainty. However, the accuracy of these methods cannot be guaranteed. Certain basic assumptions are implied, and, when these assumptions fail to hold, erroneous results can occur. The paper discusses techniques for validating the results of uncertainty analyses based on these methods.

42998 (DOE/TIC—10099) **FRESS pin failure model and its application to E-8 TREAT test.** Kalimullah. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

FRESS is a cladding rupture prediction model for an irradiated mixed-oxide LMFBR fuel pin during transient heating based only on the internal pressurization of the cladding by the fission gas released from fuel grains during the transient. The model is applied to the analysis of the hottest PNL-10-53 pin in the 7-pin E-8 TREAT test which simulates a $3/sec transient overpower. Although the uncertainties of the inputs to the temperature calculation done with the COBRA code have not been included, the uncertain input parameters to FRESS have been varied over their estimated uncertainties. The cladding rupture predictions are a few tens of milliseconds late compared to the most probable failure time detected in the test. However, these calculations seem to indicate that fisson gas pressure is a significant mechanism for causing clad rupture in this test.

42999 (DOE/TIC—10100) **Analysis of a prototypic and a simulant-experiment related to freezing in flow channels.** Hakim, S.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

An analysis is presented of two experiments, one involving simulant materials, and a second more prototypic experiment, related to freezing of molten LMFBR core material in flow channels. Good agreement is obtained between predictions and experimental results for both experiments. It is argued that simulant experiments could provide a reasonable vehicle for validation of isolated phenomena related to the freezing process while prototypic experiments provide a more realistic view of the integrated behavior of molten core material during the accident.

43000 (DOE/TIC—10101) **Analysis of TREAT transient overpower experiments using the PLUTO2 codes.** Wider, H.U.; Semenza, L.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

Pre- and post-test computer analyses of TREAT transient overpower test H6 are presented and compared with an earlier analysis of E8. The computer models used were the PLUTO code and its successor, thee PLUTO2 code. A good agreement with several events could be achieved in the post test simulations, which

supports the basic modeling in the codes used. The pre-test analyses suffered from the uncertainty in the pin failure sequence. Fission-gas preessures in the pins at failure time were on the order of 15-30 MPa in both tests. Plenum fission-gas release may have played an important role in both tests.

43001 (DP-MS—78-73) **Response of a double tube sheet structure to hydraulic pressure transients.** Yau, W.F.; Harris, S.D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 15p. (CONF-790615—8). Dep. NTIS, PC A02/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

A general procedure was developed to analyze complex tube-sheet structures under dynamic loading conditions. The top shield of a Savannah River Plant production reactor is a stainless steel box structure perforated by tubular conduits. It supports the hanging fuel assemblies and the weight of the reactor superstructure. During normal reactor operation the top shield and the fuel assemblies are submerged in water coolant. For a postualted transient induced by a loss-of-coolant, a loading profile was constructed that considered (1) reduction of bouyancy, (2) rapid pressure changes due to generation and condensation of steam, and (3) vacuum force on one side following condensation. Dynamic responses to such a loading are analytically represented by linear combinations of natural modes that satisfy a fourth-order equation of motion. Localized stress magnification in the tube-sheets of the structure is determined according to the theory of perforated plates.

43002 (GA-A—15110) **HTGR risk assessment study: highlights of update.** Joksimovic, V.; Houghton, W.J.; Blok, F.J. (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract EY-76-C-03-0167-065. 20p. (CONF-781022—43). Dep. NTIS, PC A02/MF A01.

From Meeting on nuclear power reactor safety; Brussels, Belgium (16 Oct 1978).

Phase II of the Accident Initiation and Progression Analysis (AIPA) Study of the high-temperature gas-cooled reactor (HTGR) has been completed. Event trees for core heatup have been expanded to contain about 20 additional initiating events, leading to 22 separate heatup scenarios, and continue to show the strong effect of inherent HTGR safety features resulting in a high degree of relative safety.

43003 (HEDL—SA-1595-FP) **Boilup threshold for the bottled-up transition phase pool.** Martin, F.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1978. Contract EY-76-C-14-2170. 7p. (CONF-781105—95). Dep. NTIS, PC A02/MF A01.

From ANS meeting; Washington, DC, USA (12 Nov 1978).

Since the inception of the hypothesized transition phase, for the late stages of a postulated LMFBR accident, there has been a continual effort to characterize the anticipated conditions of such a hypothetical state. To date, several techniques and methods have been employed to analyze the potential for energetic criticality. As part of this effort, an arbitrary criterian of monotonical dispersiveness has been employed as the measure of diminished recriticality potential. The various attempts to demonstrate monotonic dispersiveness have included experimental demonstrations, theoretical approaches, and integrated analysis using both. As part of this treatment, flow regime maps have been devised as a convenient method for inferring the state of dispersiveness. They included bubbly, churn turbulent, foam and drop fluidized regimes. Of these, foam and drop fluidized regimes were considered the most dispersive. The main thrust of the analysis to date, including flow regime maps, relates primarily to the open pool configuration. However, the bottled configuration may be the pertinent geometry. To date, no reliable escape path has been demonstrated for the advanced stages of core disruption, although strong potential escape mechanisms have been identified and are currently being analyzed. The bottled pool is examined in this paper.

43004 (HEDL-SA—1688) **W-1 SLSF experiment.** Simpson, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 1 Dec 1978. Contract EY-76-C-14-2170. 33p. (CONF-781144—18). Dep. NTIS, PC A03/MF A01.

From 2. US-Japan seminar on HTGR safety technology; Fuji, Japan (24 Nov 1978).

The Sodium Loop Safety Facility (SLSF) is a doubly-contained, closed sodium loop designed to test full length fast breeder reactor (FBR) fuel pins under simulated hypothetical fast reactor accident conditions. The W-1 experiment has two distinct and separate objectives. The primary objective is to evaluate fuel pin heat release characteristics during loss-of-piping integrity (LOPI) accident flow and power conditions. The Clinch River Breeder Reactor (CRBR) conditions during this accident are being used as representative of FBR's. A progression of four LOPI tests will be conducted to collect data at different fuel pin conditions. These four tests will be performed on fuel pins with (a) fresh, unrestructured fuel, (b) fresh, restructured fuel, (c) irradiated, uncracked fuel (after steady-state irradiation), and (d) irradiated, cracked fuel (after shutdown and startup). The second objective of the W-1 experiment is to determine stable boiling and recovery limits (boiling window) as a function of fuel pin power.

43005 (HEDL-TI—75002-35) **FFTF FSAR Amendment 35. Revisions to emergency plan.** (Hanford Engineering Development Lab., Richland, WA (USA)). 18 Apr 1979. Contract EY-76-C-14-2170. 53p. AT.

Supplementary information is presented for inclusion in the FFTF Final Safety Analysis Report.

43006 (JAPFNR—422) **Local flow blockage experiments in 37-pin sodium cooled bundles with grid spacers.** Uotani, M.; Haga, K.; Kikuchi, Y.; Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Oarai (Japan)). Oct 1978. 16p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States—Japanese Fast Reactor Exchange Program.

A series of out-of-pile experiments were conducted on local temperature rises due to non-heat generating blockages in 37-pin bundles. In the central blockage experiment, the central 24 subchannels of the bundle were blocked with a 5 mm thick stainless-steel plate at upstream end of a grid spacer. The blocked area was 27% of the total flow area. In the edge blockage experiment, a stainless-steel plate blocked 39 subchannels of a 1/2 edge part of the cross-sectional area. In both cases of the central and the edge blockage, the pin surface temperature attained a local peak in the grid spacer behind the blockage and decreased with the distance from the blockage. The mass exchange rate and the coolant residence time in the wake regions were evaluated from the observed temperature rises. The mass exchange rate per unit interface area behind the edge blockage agreed fairly well with that behind the central blockage. The dimensionless coolant residence time was found independent of Reynolds number except in the low number range, and the value obtained in the edge blockage experiment was about 2.4 times as much as that obtained in the central blockage experiment. When experimental results were extrapolated to the reactor condition, an edge blockage of more than 30% might cause local boiling in the wake region, while a central one would not cause local boiling in any blockage ratio less than 60%. The temperature rises in the blocked grid spacer were also discussed.

43007 (LTR—111-120) **LOFT natural circulation test analysis for 30% reactor power and high flow rate conditions.** Fausz, N.F. (Idaho National Engineering Lab., Idaho Falls (USA)). 8 Mar 1979. Contract EY-76-C-07-1570. 206p. (RE-A—78-286). Dep. NTIS, PC A10/MF A01.

The results are presented for the LOFT natural circulation test analyses for conditions of nominal high loop flow rate and 30% of nominal full power. The test cases included a loss of commercial off-site power and several cases of loss of power to the primary coolant pumps with subsequent flywheel coastdown. The cases of loss of power to the primary coolant pumps were analyzed using a variety of reactor trips and one case in which no reactor trip occurred. In addition, the transients resulting from a loss of power to the primary coolant pumps were anlayzed using various degrees of increased natural circulation flow resistance.

43008 (NUREG—0536) **Evaluation of simulated-LOCA tests that produced large fuel cladding ballooning.** Powers, D.A.; Meyer, R.O. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Feb 1979. 38p. NTIS, PC A03/MF A01.

A description is given of the NRC review and evaluation of simulated-LOCA tests that produced large axially extended ballooning in Zircaloy fuel cladding. Technical summaries are presented on the likelihood of the transient that was used in the tests, the effects of temperature variations on strain localization, and the results of other similar experiments. It is concluded that (a) the large axially extended deformations were an artifact of the experimental technique, (b) current NRC licensing positions are not invalidated by this new information, and (c) no new research programs are needed to study this phenomenon.

43009 (NUREG—0557) **Evaluation of long-term post-accident core cooling of Three Mile Island Unit 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1979. 214p. NTIS, PC A10/MF A01.

On the basis of current understanding of the accident scenario and available data, the staff reports here on its evaluation of the condition of the core and the core flow resistance as it might affect ability to cool the core by natural circulation. The natural circulation cooling capability of TMI-2 for the estimated core flow resistance and a variety of other conditions is evaluated and a comparison of the Base Case and off-nominal plant configurations is presented. The potential for and effects of natural convection core cooling are addressed, and the staff recommendations for reactor perform-

ance acceptance criteria upon initiation of natural convection are presented.

43010 (NUREG/CR—0172) **Semiscale Program description.** Ball, L.J.; Hanson, D.J.; Dietz, K.A.; Olson, D.J. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1978. Contract EY-76-C-07-1570. 211p. (TREE-NUREG—1210). Dep. NTIS, PC A10/MF A01.

This program description document presents an overview of the Semiscale Program with emphasis on the period August 1974 through August 1977. This period coincides with the period of testing of the Mod-1 system. The overall program experimental approach is discussed and the accomplishments achieved in the testing and analysis are summarized. The description of the experimental approach reflects both immediate and long-term goals of the program and identifies the system configurations and modifications that are applied in achieving those goals. Emphasis is placed on the accomplishments achieved in the Mod-1 portion of the program. The Mod-1 system, the basis for selection of that system, the data acquisition, and documentation efforts are described.

43011 (NUREG/CR—0255) **CONTEMPT-LT/028: a computer program for predicting containment pressure-temperature response to a loss-of-coolant accident.** Hargroves, D.W.; Metcalfe, L.J.; Wheat, L.L.; Niederauer, G.F.; Obenchain, C.F. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1979. Contract EY-76-C-07-1570. 248p. (TREE—1279). Dep. NTIS, PC A11/MF A01.

CONTEMPT-LT is a digital computer program, written in FORTRAN IV, developed to describe the long-term behavior of water-cooled nuclear reactor containment systems subjected to postulated loss-of-coolant accident (LOCA) conditions. The program calculates the time variation of compartment pressures, temperatures, mass and energy inventories, heat structure temperature distributions, and energy exchange with adjacent compartments. The program is capable of describing the effects of leakage on containment response. Models are provided to describe fan cooler and cooling spray engineered safety systems. An annular fan model is also provided to model pressure control in the annular region of dual containment systems. Up to four compartments can be modeled with CONTEMPT-LT, and any compartment except the reactor system may have both a liquid pool region and an air—vapor atmosphere region above the pool. Each region is assumed to have a uniform temperature, but the temperatures of the two regions may be different.

43012 (NUREG/CR—0590) **Evaluation of fuel rod behavior during Test LOC-11.** Cook, T.F. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1979. Contract EY-76-C-07-1570. 115p. (TREE—1328). Dep. NTIS, PC A06/MF A01.

The postirradiation analysis is presented for the behavior of four pressurized water reactor type fuel rods which were subjected to loss-of-coolant (LOC) conditions during Test LOC-11. The major objectives of this test were to evaluate cladding deformation during a loss-of-coolant transient, and to characterize the overall behavior of fuel rods when exposed to conditions expected during a double-ended cold leg break. A discussion of fuel rod behavior during Test LOC-11 is presented. The overall posttest condition of the fuel rods is evaluated. Peak cladding temperatures and temperature gradients are estimated, and cladding deformation, both ballooning and collapse, is analyzed. Fuel pellet changes during the transient are assessed, and fuel rod power determined by chemical burnup and flux wire analysis is compared with in-test measurements of rod power.

43013 (NUREG/CR—0595) **Assessment of intergranular fracture within unrestructured UO_2 fuel due to film boiling operation.** Cronenberg, A.W.; Yackle, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1979. Contract EY-76-C-07-1570. 101p. (TREE—1330). Dep. NTIS, PC A06/MF A01.

Extensive grain boundary separation has been found to occur within the unrestructured region of UO_2 fuel pellets as a result of in-pile testing of nuclear fuel rods under film boiling conditions. Since, in general, the grain size in the unrestructured region is only about 5 microns in diameter, unrestructured fuel experiencing grain boundary separation has been commonly referred to as powdery fuel. Because fuel in such a condition will result in loss of pellet structural integrity, an understanding of the cause of powdering is of interest to the overall assessment of thermal fuel behavior under postulated accident conditions, in which film boiling leading to high fuel temperatures occurs. This report examines the experimental conditions leading to powdering and presents calculations demonstrating that such grain boundary separation (intergranular fracture) can be explained by the combination of a severe loss of grain boundary strength at the elevated temperatures experienced under film boiling conditions, and the high tensile stresses induced by requenching from such film boiling conditions, thus resulting in a desintering of unrestructured fuel to a powdery form.

43014 (NUREG/CR—0599) **Analysis of superheated wall effects during refill at small scale.** Crowley, C.J.; Rothe, P.H. (Creare, Inc., Hanover, NH (USA)). Dec 1978. 172p. (CREARE-TN—287). NTIS, PC A08/MF A01.

A semi-empirical analysis is presented to calculate the timing and rate of delivery of emergency core coolant (ECC) to the lower plenum of a pressurized water reactor. Emphasis is given to the physical process of ECC bypass by upward flowing steam in the reactor downcomer and the amplification of this effect by steam produced at the superheated vessel walls. The analysis is successfully compared with over 350 tests at 1/15 scale. Sensitivity studies are reported which quantify modeling uncertainties and display the strengths and weaknesses of the analysis.

43015 (NUREG/CR—0620) **Numerical method of the aerosol behavior reference code, CRAB.** Jordan, H.; Vaishnavi, B.; Gieseke, J.A. (Battelle Columbus Labs., OH (USA)). Jan 1979. 57p. (BMI—2016). NTIS, PC A04/MF A01.

A numerical method using arbitrary nodal spacing, linear elements and collocation at the nodal points for solving the aerosol agglomeration equation is described. A computer code employing this method has been developed and is named the CRAB (Contained Radioactive Aerosol Behavior) code. Comparisons between analytic solutions for two kernels, $K(x,x')=1$ and $K(x,x')=x+x'$, and corresponding numerical calculations are given. In addition, a comparison run between the CRAB and two alternative codes, PARDISEKO-III and HAARM-3, for a lognormal initial distribution and a Brownian kernel is exhibited. An appendix traces the development of the present numerical method from related, but less suitable methods.

43016 (NUREG/CR—0645) **Multidimensional analysis of fluid flow in the loft cold leg blowdown pipe during a loss-of-coolant experiment.** Demmie, P.N.; Hofmann, K.R. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1979. Contract EY-76-C-07-1570. 91p. (TREE—1323). Dep. NTIS, PC A05/MF A01.

A computer analysis of fluid flow in the Loss-of-Fluid Test (LOFT) cold leg blowdown pipe during a loss-of-coolant experiment (LOCE) was performed using the computer program K-FIX/MOD1. The purpose of this analysis was to evaluate the capability of K-FIX/MOD1 to calculate theoretical fluid quantity distributions in the blowdown pipe during a LOCE for possible application to the analysis of LOFT experimental data, the determination of mass flow, or the development of data reduction models. A rectangular section of a portion of the LOFT blowdown pipe containing measurement Station BL-1 was modeled using time-dependent boundary conditions. Fluid quantities were calculated during a simulation of the first 26 s of LOFT LOCE L1-4. Sensitivity studies were made to determine changes in void fractions and velocities resulting from specific changes in the inflow boundary conditions used for this simulation.

43017 (NUREG/CR—0670) **Modular approach to fault tree analysis.** Olmes, J.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Aug 1977. 339p. (MITNE—209). NTIS, PC A15/MF A01.

An analytical method to describe fault tree diagrams in terms of their modular composition is developed. Fault tree structures are characterized by recursively relating the top tree event to all its basic component inputs through a set of equations defining each of the modules for the fault tree. It is shown that such a modular description is an extremely valuable tool for making a quantitative analysis of fault trees. The modularization methodology has been implemented into the PL-MOD computer code, written in PL/1 language, which is capable of modularizing fault trees containing replicated components and replicated modular gates. PL-MOD in addition can handle mutually exclusive inputs and explicit higher order symmetric (k-out of - n) gates.

43018 (NUREG/CR—0676) **Aerosol measurements and modeling for fast reactor safety. Annual report for FY 1978.** Gieseke, J.A.; Jordan, H.; Lee, K.W.; Reed, L.D. (Battelle Columbus Labs., OH (USA)). Jan 1979. 70p. (BMI—2021). Dep. NTIS, PC A05/MF A01.

The areas of major activity during that year were: development and subsequent sensitivity study of the HAARM-3 code; development of a code to study multiple zone effects; completion of the basic form of the reference code, CRAB; and measurements on fuel aerosol particles. Results of these activities are presented in the main body of this report. In addition, an appendix contains a compilation of experimental data on nuclear aerosols that have become available since the publication of a similar compilation in the previous annual report for this program.

43019 (NUREG/CR—0678) **Analysis of the heat and mass transfer processes of a UO_2 bubble in sodium for the Fuel Aerosol Simulant Test (FAST).** Tobias, M.L. (Oak Ridge National Lab., TN (USA)). 17 Apr 1979. Contract W-7405-ENG-26. 46p. (ORNL/NUREG/TM—307). Dep. NTIS, PC A03/MF A01.

The anticipated behavior of uranium oxide vapor bubbles produced by the capacitor discharge vaporization (CDV) method in

the Fuel Aerosol Simulant Test (FAST) Facility is discussed on the basis of relatively simple physical models. Results of calculations for the rate of bubble rise and for heat and mass transfer rates are presented. Parametric studies indicate that future analysis efforts should emphasize the diffusion condensation process and the loss of heat from the bubble by radiation. Transfer of heat in the surrounding sodium is rapid enough that simplified models should be adequate. No important effects were noted in connection with bubble depth, initial quantity of UO_2, or initial superheat.

43020 (NUREG/CR—0692) **Reports distributed under the NRC Reactor Safety Research Foreign Technical Exchange Program. Volume VI, July—December 1978.** Queener, D.S. (Oak Ridge National Lab., TN (USA)). 6 Apr 1979. Contract W-7405-ENG-26. 111p. (ORNL/NUREG/NSIC—159; TID—3362(Vol.6)). Dep. NTIS, PC A06/MF A01.

Lists of documents exchanged during the second half of 1978 under agreements between the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research and the governments of France, Federal Republic of Germany, Japan, and the United Kingdom are presented. These agreements cover safety research on high-temperature gas-cooled reactors, light-water reactors, and fast reactors. During this period, the NRC received 46 reports from France, 72 from the Federal Republic of Germany, 43 from Japan, and 93 from the United Kingdom. In return, the NRC sent 177 U.S. light-water reactor safety research reports to each of these four countries, 26 fast reactor safety research reports to all except France, and 7 HTGR research reports to Japan.

43021 (NUREG/CR—0721) **LMFBR fuel analysis. Task A: oxide fuel dynamics. Final report, October 1977—September 1978.** Dhir, V.K.; Frank, M.; Kastenberg, W.E.; McKone, T.E. (California Univ., Los Angeles (USA). Dept. of Chemical, Nuclear, and Thermal Engineering). Mar 1979. 85p. NTIS, PC A05/MF A01.

Three aspects of LMFBR safety are discussed. The first concerns the potential reactivity effects of whole core fuel motion prior to pin failure in low ramp rate transient overpower accidents. The second concerns the effects of flow blockages following pin failure on the coolability of a core following an unprotected overpower transient. The third aspect concerns the safety related implications of using thorium based fuels in LMFBR's.

43022 (NUREG/CR—0737) **LMFBR fuel analysis. Task B. Post-accident heat removal. Final report, October 1977—November 1978.** Catton, I.; Dhir, V.K.; Brinsfield, W.A.; McDonough, J.M.; Ostrander, N.D. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Nov 1978. 77p. NTIS, PC A05/MF A01.

This Task B Annual Report presents a review of PAHR problems and UCLA views upon areas that include debris bed phenomena, molten pool growth, gas film boundaries and crusts, and the influence of basemat conduction upon pool formation and evolution. Directed toward FFTF applications, the review introduces plausible circumstances for the formation of non-coolable debris beds, and so leads to crude estimates of the initial dimensions of core debris distributions for pool growth problems. The GROWS code is reviewed and examples given using initial conditions derived from those estimates.

43023 (NUREG/CR—0760) **SIMMER-II analysis of the R-7 TREAT test.** Bohl, W.R. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 30p. (LA—7763-MS). Dep. NTIS, PC A03/MF A01.

The SIMMER-II code was used in a simulation of the R-7 loss-of-flow TREAT test. Comparison with the test scenario encompassed thermocouple data, flowmeter tracers, hodoscope data, and the posttest configuration. Reasonably successful results were obtained on the overall heat balance. The calculated boiling time was within 0.2 s of the experimental result, and respectable agreement with the integrated lower flowmeter trace was achieved over the first 2 s of boiling. Although the details of cladding relocation and blockage formation could not be well simulated, the calculated fuel motion appears to be plausible given the available experimental information. It was further concluded that this type of study is quite useful for revealing areas for model improvement.

43024 (NUREG/CR—0763) **Application of implicit numerical methods to problems in two-phase flow.** Mahaffy, J.H.; Liles, D.R. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 15p. (LA—7770-MS). Dep. NTIS, PC A02/MF A01.

A numerical method for treating two-phase flow in pipes is presented which incorporates the use of a partially implicit scheme in regions of relatively low flow velocity and a fully implicit treatment in regions of high velocity. This method takes advantage of the lower cost per iteration of the partially implicit scheme, without being limited by its conditional stability. Applications of this approach to water reactor blowdown calculations produce reductions in computer time by factors of 2-4 without a significant loss of accuracy.

43025 (NUREG/CR—0816) **Pretest prediction of the W-1 SLSF experiment using the COMMIX-1A computer code.** Domanus, H.M.; Chen, M.J.; Sha, W.T. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 105p. (ANL-CT—79-33). Dep. NTIS, PC A06/MF A01.

The numerical simulation of a 19-rod LMFBR fuel assembly undergoing a Loss of Piping Integrity (LOPI) transient has been carried out using the COMMIX-1A computer code. COMMIX-1A is a three-dimensional, transient, single-phase, thermal-hydraulic computer code. The results are compiled to form a pre-test prediction of the W-1 in-pile experiment which will begin in the near future. Since COMMIX-1A performs single-phase analyses, the simulation is terminated when boiling first occurs in the fuel assembly.

43026 (PB—288901) **Scaling of pressure and subcooling for countercurrent flow. Quarterly progress report, 1 April-30—June 1978.** Rothe, P.H.; Crowley, C.J. (Creare, Inc., Hanover, NH (USA)). Nov 1978. Contract NRC-04-75-162. 73p. NTIS PC A04/MF A01.

Recent results of a continuing program to develop semi-empirical models of lower plenum filling after a hypothetical PWR LOCA are presented. The idealized situation of countercurrent flow in a 1/15-scale PWR model is specifically addressed here. For saturated water behavior in small-scale facilities, it is shown that the dimensionless J^* parameters properly scale the effects of vessel size, injection rate, and (for the first time with steam and water) vessel pressure. Building on previous work, new correlation concepts are proposed to account for the effects of condensation on ECC bypass. Comparison with new data over an increased range of pressures and subcoolings shows that for a given injection rate, the effects of condensation can be accounted solely in terms of thermodynamic ratio rather than pressure or subcooling independently. The data indicate that subcooling has a weaker effect on ECC bypass than was previously believed. The data also reveal a transition in behavior at a thermodynamic ratio near unity; at values below this transition the behavior is close to that of saturated water at all pressures tested. These findings suggest a need for caution when taking credit for the benefits of subcooling on ECC bypass in calculated LOCA transients.

43027 (PB—288968) **Summary of reported droplet size distribution data in dispersed two-phase flow. Topical report.** Smith, R.V.; Azzopardi, B.J. (Wichita State Univ., KS (USA)). Oct 1978. Contract NRC-04-77-133. 37p. NTIS PC A03/MF A01.

Summary tables of reported work on droplet size and distribution in dispersed two phase flow are presented. Results for tests with constant flow across sections, flow from nozzles, orifices and sprays and flow in liquid - liquid systems is reported. A summary table of predictive expressions for droplet size and distribution is given, and the apparent influence of gas velocity, geometry and fluid properties is reported.

43028 (TFBP-TR—317) **Operational transient test series OPTRAN 1-2: experiment specification document.** Semken, R.S. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 18p. Dep. NTIS, PC A02/MF A01.

Several test series are being conducted in the Power Burst Facility (PBF) to determine the behavior of light water reactor fuel rods during transient reactor conditions. The PBF Operational Transient (OPTRAN) test series has the overall objective of evaluating fuel rod behavior during conditions simulating anticipated operational transients with and without scram in light water reactors. Test OPTRAN 1-2, the second in the series, will be comprised of four preirradiated GE BWR/6-type fuel rods (8 x 8 configuration) each shrouded for environmental isolation. Included are the specifications for the fuel rods, the test train assembly, and the instrumentation. Complete information on the design characteristics of the irradiated GE BWR/6 fuel rods is not available at the present time.

43029 (TREE—1361) **COMCAN II-A: a computer program for automated common cause failure analysis.** Rasmuson, D.M.; Marshall, N.H.; Wilson, J.R.; Burdick, G.R. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1979. Contract EY-76-C-07-1570. 84p. Dep. NTIS, PC A05/MF A01.

The user's manual for COMCAN II-A, a computer program that identifies possible common causes for the failure of fault tree minimal cut sets, is presented. The program also contains options to help an analyst construct common locations and to assign susceptibilities to the components. The program is written in FORTRAN IV for the CDC CYBER-76 computer. A main feature of the program is its ability to identify minimal cut sets of any order with failure potential due to a single secondary failure (common cause).

43030 (UCID—18175) **On-line structural response analysis: using the extended Kalman estimator/identifier.** Candy, J.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 May

1979. Contract W-7405-ENG-48. 68p. Dep. NTIS, PC A04/MF A01.

This report disucsses the development of on-line state and parameter estimators used to analyze the structural response of buildings. The estimator/identifier is an extended Kalman filter (EKF), which has been applied with great success in other technological areas. It is shown that the EKF can perform quite well on simulated noisy structural response data.

43031 (UCRL—13985-I) **Seismic Safety Margins Research Program (Phase I). Project VII. Systems analysis specification of computational approach.** Wall, I.B.; Kaul, M.K.; Post, R.I.; Tagart, S.W. Jr.; Vinson, T.J. (Nuclear Services Corp., Campbell, CA (USA)). Feb 1979. Contract W-7405-ENG-48. 162p. Dep. NTIS, PC A08/MF A01.

An initial specification is presented of a computation approach for a probabilistic risk assessment model for use in the Seismic Safety Margin Research Program. This model encompasses the whole seismic calculational chain from seismic input through soil-structure interaction, transfer functions to the probability of component failure, integration of these failures into a system model and thereby estimate the probability of a release of radioactive material to the environment. It is intended that the primary use of this model will be in sensitivity studies to assess the potential conservatism of different modeling elements in the chain and to provide guidance on priorities for research in seismic design of nuclear power plants.

43032 (UCRL—13986-I) **Seismic safety margins research program. Phase I. Project VII: systems analysis specifications of computational approach.** Collins, J.D.; Hudson, J.M.; Chrostowski, J.D. (Wiggins (J.H.) Co., Redondo Beach, CA (USA)). Feb 1979. Contract W-7405-ENG-48. 166p. Dep. NTIS, PC A08/MF A01.

A computational methodology is presented for the prediction of core melt probabilities in a nuclear power plant due to earthquake events. The proposed model has four modules: seismic hazard, structural dynamic (including soil-structure interaction), component failure and core melt sequence. The proposed modules would operate in series and would not have to be operated at the same time. The basic statistical approach uses a Monte Carlo simulation to treat random and systematic error but alternate statistical approaches are permitted by the program design.

43033 (UCRL—81884) **Seismic safety margins research program overview.** Tokarz, F.J.; Smith, P.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1978. Contract W-7405-ENG-48. 31p. (CONF-790408—4). Dep. NTIS, PC A03/MF A01.

From 3. ASCE specialty conference on the structural design of nuclear plant facilities; Boston, MA, USA (2 Apr 1979).

A multiyear seismic research program has been initiated at the Lawrence Livermore Laboratory. This program, the Seismic Safety Margins Research Program (SSMRP) is funded by the U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. The program is designed to develop a probabilistic systems methodology for determining the seismic safety margins of nuclear power plants. Phase I, extending some 22 months, began in July 1978 at a funding level of approximately $4.3 million. Here we present an overview of the SSMRP. Included are discussions on the program objective, the approach to meet the program goal and objectives, end products, the probabilistic systems methodology, and planned activities for Phase I.

43034 (WARD-SR—3045-8) **Comparison of experiment with analysis of a water-filled plastically deforming pipe using the computer code PTA-1.** Mak, M. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Oct 1978. Contract EY-76-C-02-3045-029. 45p. AT.

In a liquid metal cooled fast breeder reactor, pressure pulses resulting from hypothetical core disruptive accidents (HCDA) or sodium/water reactions may plastically deform the thin-walled piping typically used in the sodium systems. The plastic deformation has a significant effect on pressure-transient propagation since it limits the peak pressure of the fluid transmitted out of a pipe to the pressure approximately causing the pipe to yield if the pipe is sufficiently long. PTA-1 is a computer code developed by the Argonne National Laboratory for computing the transmission of pressure pulses through the system and the effect of plastic deformation of the piping on pressure-transient propagation. In order to provide experimental data to validate computer codes developed for the safety evaluations of reactors, Stanford Research Institute has completed a series of experiments of simple piping systems (Reference 2). One of these experiments, the flexible straight pipe test FP-SP-191, has been adopted here to verify the PTA-1 computed responses. Details of this test are described.

43035 (WARD-SR—3045-9) **Assessment of debris transport methods in horizontal LMFBR piping for PAHR conditions.** Brown, R.G. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Apr 1979. Contract EY-76-C-02-3045-029. 59p. AT.

In assessing the long-term coolability of debris following a postulated core disruptive accident, the distribution of the fragmented fuel and steel must first be determined. One area which has received relatively little attention is the potential for debris transport into the primary piping and the distribution of settled debris in the piping system. A review of existing methods for analyzing particle transport in horizontal pipes has been performed to assess the adequacy of these techniques for LMFBR post-accident heat removal (PAHR) evaluations. It was concluded that the existing methods for analyzing particle settling are inappropriate for the PAHR conditions of high density ratio, low concentration mixtures flowing in large pipes. Therefore, a modified correlation has been developed to predict the critical deposition velocity for solid-liquid flow in horizontal pipes for conditions of interest in PAHR evaluations.

43036 Overview of NRC's emergency core coolant bypass research. Beckner, W.D. (Nuclear Regulatory Commission, Washington, DC). *Nucl. Saf.;* **20**: No. 3, 267-275(May 1979).

An overview of research sponsored by the Nuclear Regulatory Commission on countercurrent flow flooding in relationship to the emergency core-coolant (ECC) bypass phenomenon is presented. Progress has been made in understanding the transient ECC penetration problem in small-scale models of reactor pressure vessels. Experiments have been made to study ECC penetration in the presence of transient countercurrent steam flow and superheated vessel walls over a variety of test conditions. The results of this work have been used to develop models and correlations to analyze the ECC injection phase of the hypothetical loss-of-coolant accident (LOCA). The applicability and limitations of this work in relation to best-estimate evaluations of the LOCA and in the licensing process are examined.

43037 Review of fire protection in the nuclear facilities of the Atomic Energy Commission, 1947—1975. Maybee, W.W. *Nucl. Saf.;* **20**: No. 3, 294-307(May 1979).

In the 28 years in which it grew from a temporary wartime bomb development program to a federal agency with over $30 billion worth of facilities housing much of the nation's advanced research efforts, the Atomic Energy Commission set many records for safety. Among the best was a cumulative fire loss ratio of 12 cents per $100 of value. A 1969 fire—one of four in its history that exceeded $1 million in loss—incurred damages totaling $26 million and prompted major additions to its fire protection programs. The added programs, encompassing additional fire protection engineers, new protection systems, independent inspection programs, and new performance-based goals, resulted in an order-of-magnitude improvement. The cumulative fire loss ratio after 1969 was 0.06 cents per $100 of value, a record few industries have ever achieved.

43038 Nuclear plant fire incident data file. Sideris, A.G.; Hockenbury, R.W.; Yeater, M.L.; Vesely, W.E. *Nucl. Saf.;* **20**: No. 3, 308-318(May 1979).

A computerized nuclear plant fire incident data file was developed by American Nuclear Insurers and was further analyzed by Rensselaer Polytechnic Institute with technical and monetary support provided by the Nuclear Regulatory Commission. Data on 214 fires that occurred at nuclear facilities have been entered in the file. A computer program has been developed to sort the fire incidents according to various parameters. The parametric sorts that are presented in this article are significant since they are the most comprehensive statistics presently available on fires that have occurred at nuclear facilities.

43039 Selected safety-related events reported in January and February 1979. Casto, W.R. (comp.). *Nucl. Saf.;* **20**: No. 3, 351-354(May 1979).

Of the licensee event reports received during January and February 1979, three are reviewed because of their uniqueness and general interest. One incident involved a spill of contaminated water at North Anna-1 which resulted in the contamination of 13 operating personnel. The other two incidents involved short periods (e.g., rapid reactivity increases), one due to an accidental increase in power demand at the Cooper reactor and the other to rapid rod withdrawal during startup at the Oyster Creek-1 reactor. All three events are summarized.

43040 Generalized theory for predicting mass effluence during reactor reflooding. Sun, K.H.; Duffey, R.B. (Electric Power Research Inst., Palo Alto, CA). *Nucl. Technol.;* **43**: No. 1, 22-27(Apr 1979).

A simple generalized model has been developed to predict the rate of mass effluence during bottom reflooding, which is an emergency core cooling mechanism for the light water reactors. The effluence of mass during reflooding is important not only for determining the core heat transfer rate, but also the overall system pressure drop characteristics. The model accounts for the propagation of the quench front and vaporization below the quench front. It

treats the quench front explicitly as a reference for mass and energy balance considerations. Comparisons were made between the model predictions and full-length bundle data with two power profiles and basic single-tube data. The results demonstrate that the rate of mass effluence is strongly coupled to the rate of quench front propagation in the core.

43041 Dozimetriya pri radiatsionnykh avariyakh. (Dosimetry during radiation accidents). Kraitor, S.N. Moscow, USSR; Izdatel'stvo Atomizdat (1979). 280p.

The book reviews the practical and research work in radiation accident dosimetry carried out in the USSR and abroad. It contains an analysis of the most typical radiation accidents caused by spontaneous chain reactions at critical assemblies and research reactors. Patterns of gamma and neutron radiation field formation in experimental rooms containing critical assemblies, and their influence on the depth dose distribution in the human body following an accident are examined. A detailed account of the methods of individual γ—n-radiation dosimetry and neutron spectrometry, as well as a description of dosimeters and spectrometers used for individual dose monitoring in accident-prone areas and in accident dosimetry research is presented. The book provides an insight into some organizational problems of individual accident control management, based on the IKS-A—GNEIS system, including the exposed personnel dosimetric examination at the accident area and in a radiological center. The book is intended for research and technical workers, workers of radiation safety facilities and radiological centers, higher school students and post-graduates. 295 references, 119 figures, 55 tables.

43042 Quake's motion modeled in relay test. Calhoun, H.J. (Westinghouse Electric Corp., Newark, NJ). *Electr. World;* **190**: No. 7, 50-52(1 Oct 1978).

Relays in safety-related functions at nuclear plants can now be tested seismically at lower frequencies and with more meaningful force mangnitudes than ever before. A massive, computer-controlled machine shakes the relays with a complex set of frequencies to determine their fragility. NRC has examined the technique by which relay movement is programmed, and has accepted it as an adequate means to do so. The machine, installed last fall, will improve the ability of manufacturers to produce more rugged, vibration-resistant relays, thus increasing system reliability.

43043 Effects of dissolved gas and downstream geometry during blowdown of a subcooled liquid. Cha, Y.S.; Henry, R.E. (Argonne National Lab., IL). pp 95-104 of Fluid transients and acoustics in the power industry. Papadakis, C.; Scarton, H. (eds.). New York, NY; American Society of Mechanical Engineers (1978).

The effects of dissolved gas and downstream geometry during a blowdown transient were investigated experimentally. It was observed that dissolved gas did not significantly affect the blowdown process if no additional surface was available in the test section to provide nucleation sites. However, if sufficient nucleation sites were available in the system, large amplitude, continuous pressure oscillations were observed when the system contained a large amount of dissolved gas. The delay in blowdown times caused by these oscillations was between 20 to 30%. The amplitude of oscillations increased with increasing initial pressure in the blowdown vessel and the oscillatory frequency was between one to five cycles per second. These oscillations were likely to be associated with the so-called density-wave oscillations sometimes encountered in a two-phase flow system. A single-phase, incompressible, quasi-steady model was developed to predict the pressure history in the blowdown vessel and the discharge flowrate. This model is able to predict the blowdown process as accurately as one can assess the polytropic behavior of the initial gas volume in the vessel.

43044 Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978). 209p. (CONF-780507—P1). $42.00 (3 Vol. set).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Separate abstracts were prepared for the individual papers included.

43045 Probabilistic methods in the nuclear regulatory process. Levine, S. (Nuclear Regulatory Commission, Washington, DC). pp I.1.1-I.1.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The judicious application of probabilistic methods can help reduce present regulatory uncertainties. Moreover, the acceptability of such techniques is gaining support. While the application of these techniques, in the manner of the Reactor Safety Study (WASH-1400), to each plant would be a formidable task, a probabilistic approach can guide the decisionmakers involved in the licensing process. Several examples of the use of a probabilistic approach are given. The risk assessment tools will be improved under a plan submitted to Congress to improve reactor safety. The question of acceptable risk criteria will be addressed in the ongoing NRC research program. It is expected that the continued use of risk assessment techniques will help to improve the efficiency and the stabilization of the regulatory process by focusing NRC staff attention on the important contributors to risk.

43046 Probabilistic approach in licensing process in Japan. Togo, Y. (Univ. of Tokyo, Japan); Takashima, S. pp I.2.1-I.2.16 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Typical areas in which the probabilistic approach is applied to the licensing process in Japan are described. They are an air-crash accident, turbine missile evaluation, loss of all ac powers, evaluation of atmospheric diffusion, an aseismic design and ECCS evaluation.

43047 Probabilistic methods in reactor licensing. Tanguy, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). pp I.3.1-I.3.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Four years after the publishing of the WASH-1400 report, probabilistic methods still play little part in reactor licensing. One of the reasons could be the need for the general public of a maximum credible accident. Probabilistic methods will play a significant role in licensing only if they are introduced progressively and at different levels: assistance to safety assessments with present safety rules, introduction of new probabilistic safety criteria, definition of an overall risk acceptance level, use of operational experience feedback. The present situation in France is discussed, with the progress achieved and the difficulties met, both on PWR and on LMFBR. For the future, reactor licensing should be more probabilistic, but this requires an international consensus, which could be easily developed for the fast breeders.

43048 Probabilistic methods in reactor licensing. Birkhofer, A.; Koeberlein, K. (Gesellschaft fuer Reaktorsicherheit (GRS) mbH, Garching/Munich, Germany). pp I.4.1-I.4.9 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The present state of application as well as future prospects and problems of both reliability and risk analysis are discussed. The application of reliability analysis in some areas of reactor licensing can be more strengthened. Important condition for a broader application of these methods would be a further reduction of uncertainties by appropriate means and a more consistent comparison among different technologies. Up to now risk analyses have influenced reactor licensing by supplying background information for safety assessment. It seems neither necessary nor useful to base reactor licensing directly on risk analysis. Not only technical but even more political and legal aspects are decisive for this judgement. However, in a more general sense, it can be expected that risks analysis will play a more important role in reactor licensing, for goals like homogenisation of safety concepts or planning and evaluation of emergency procedures.

43049 Socio-economic aspects of risk-benefit decision making. Whipple, C. (EPRI, Palo Alto, CA). pp XI.2.1-XI.2.4 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Technical/economic input, public input, and institutional input in risk-benefit decision making are characterized and theories of risk acceptability are discussed.

43050 Public reception for nuclear energy. Lave, L. (Carnegie-Mellon Univ., Pittsburgh, PA). pp XI.3.1-XI.3.8 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The reasons for the public mistrust of nuclear power are reviewed. Some theories on how society makes decisions on such matters are discussed. Behavior concerning risky situations is also examined.

43051 Influence of probabilistic safety analysis on design and operation of PWR plants. Bastl, W.; Hoertner, H.; Kafka, P. (Gesellschaft fuer Reaktorsicherheit, Garching/Munich, Germany). pp II.1.1-II.1.20 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper gives a comprehensive presentation of the connections and influences of probabilistic safety analysis on design and operation of PWR plants. In this context a short historical retrospective view concerning probabilistic reliability analysis is given. In the main part of this paper some examples are presented in detail, showing special outcomes of such probabilistic investigations. Additional paragraphs illustrate some activities and issues in the field of probabilistic safety analysis.

43052 Application of multi-attribute decision theory to the underground siting of nuclear power plants. Smith, J.H; Miles, R.F. Jr.; Goldsmith, M. (Jet Propulsion Lab., Pasadena, CA). pp IV.4.1-IV.4.16 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A study of the economic feasibility, effectiveness, and necessity for underground construction of nuclear power plants is described. A key step in the overall process is for the decision analyst to determine the preferences of the various interested parties for the multitude of potential site/construction mode possibilities. Considering the number and complexity of the attributes, it was decided to apply multi-attribute decision theory, a formal mathematical method, to the problem. The first step is to determine which attributes are deemed important by the interested parties (or decision-makers). This was accomplished in a set of interviews with selected individuals who represented a variety of viewpoints. The highest ranked attribute was that of public safety, although different measures of the attribute were preferred by different persons. As the problem was posed to the interviewees, the rating of the attribute would depend on the calculated consequences of a serious accident as well as the individual's own perception of the likelihood of the accident and the value of the calculated consequences. Cost of electricity to the consumer was generally the second most important factor listed by the interested parties. Other attributes were listed in differing, but lesser rank by each person. The next step is to take the engineering results back to the interested parties, and through a formal interrogation process determine their numerical value judgements for the various attributes, including the trade-offs between attributes. Unfortunately, the time for conduct of the work ran out before the second round of interviews could be accomplished.

43053 Public attitudes in relation to the risks presented by new technologies. Cave, L. (Univ. of California, Los Angeles); Holmes, R.E.; Holmes, P.J. pp IV.8.1-IV.8.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Studies on societal attitudes during the nineteenth century to risks introduced by new technologies indicate that the present day reluctance on the part of society to accept a level of risk, which on a national basis appears to be insignificant, in order to have the benefits of a new technology at a reasonable cost, may not be a new phenomenon. Conditions are postulated in which historical data on public attitudes to risk are valid, and the application of this approach is illustrated by a study of societal attitudes in the nineteenth century to the risks presented by the new technology of railway travel in the United Kingdom. It is concluded that the interpretation of relevant data from the abundant historical records available may provide a valuable insight into the reaction of society to present-day and future technological risks.

43054 Containment design options for the HTGR: an application of probabilistic risk assessment. Barsell, A.W.; Orvis, D.D. (General Atomic Co., San Diego, CA). pp V.7.1-V.7.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

An evaluation of two alternatives to conventional steel-lined closed containment has been performed for a 3000 MW(t) high temperature gas cooled reactor (HTGR) through application of probabilistic risk assessment (PRA). The evaluation is based on adaptation of an extensive PRA performed for conventional containment and is believed to be indicative of what may be achieved. Use of an unlined closed containment, which could result in cost savings of about $14 million (1976 dollars), appears to demonstrate acceptable risk as well as meet current licensing guidelines. Similarly, use of a vented confinement building, which promises plant savings of the order of $40 million, appears to afford acceptable risk when fission product release from the primary coolant system is reduced by pumping down the system to storage during event sequences which result in core heatup.

43055 Probabilistic evaluation of mispositioned ECCS motor operated valves in Westinghouse NSSS. Barlow, R.T.; Hill, R.A.; McIntire, D.C.; O'Brien, J.F. (Westinghouse Electric Corp., Pittsburgh, PA). pp XII.6.1-XII.6.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

During the past few years the definition of single active failure has been expanded to include the spurious action of a powered component. The main emphasis for this expansion in the definition of active failure came from the NRC Staff. Their concern is documented in Branch Technical Positions which require electrical power lockout of certain motor operated valves which if spuriously moved during an accident could defeat safety system response. These positions further require fluid system design changes instead of power lockout for certain other valves. This paper is a summary of the methodology and results of the evaluation performed to address the NRC positions. This evaluation provides technical justification for the reliable operation of certain Emergency Core Cooling System (ECCS) motor operated valves. It is intended that this treatment of a single failure issue will increase the awareness of the industry to the potential role of quantitative probabilistic analysis in determining failure criteria for Nuclear Power Generating Stations.

43056 Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978). 584p. (CONF-780507—P2). $42.00 (3 Vol. set).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Separate abstracts were prepared for the individual papers included.

43057 Uncertainty propagation through computer codes. Dahlgren, D.A.; Steck, G.P.; Easterling, R.G.; Iman, R.L. (Sandia Labs., Albuquerque, NM). pp II.3.1-II.3.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The propagation of uncertainty through computer codes has important applications in reactor safety studies. This study reviews a class of techniques for uncertainty propagation and selects the Response Surface and Monte Carlo techniques for further investigation. Three problems were designed for testing the techniques. The Monte Carlo technique was dropped after the first test problem due to the variability of its estimators. The results indicate the Response Surface technique can result in the successful propagation of probability distributions through complex computer codes. It also defines the important variables and sensitivity studies can be readily performed.

43058 Bases and criteria for the selection of response surface parameters for the statistical assessment of a LOCA. Sheron, B.W. (Nuclear Regulatory Commission, Washington, DC). pp II.4.1-II.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A methodology for the selection of parameters to be used in the response surface approximation of Loss-of Coolant Accident analysis codes for statistical assessment is presented. Effects of component and system failures not considered in the response surface equation on the statistical results are also discussed. Finally, a consideration of the relationships between the analysis code and reality is discussed, and preliminary analysis of the prediction capability of the RELAP code to 16 Semiscale tests is presented.

43059 Approximate ATWS study to include parameter variations and equipment reliability in probabilistic accident analysis. Thadani, A.C. (USNRC, Washington, DC); Hanauer, S.H.; Ornstein, H.L.; Easterling, R.G. pp II.5.1-II.5.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Calculations based on deterministic computer codes were used to identify important parameters and equipment used to mitigate consequences of PWR ATWS events. A factorial matrix was developed and an approximate response surface was obtained using regression analysis from calculations conducted with deterministic codes. Using estimates of parameter distributions and equipment failure probabilities and impacts, Monte Carlo calculations were performed to get the peak pressure probability distributions for different designs. While the method provides an easy estimate of parameter and equipment effects on important plant variables, selection of parameters and determination of the response surface require a considerable number of calculations using deterministic models. Further effort is needed to assess the impact of the assumptions of

linearity and independence and the distributions of the parameters selected that were used in these calculations.

43060 Probabilistic analysis of codes and calculational results in nuclear reactor safety. Beck, W.; Schmidt, F.A.R. (Univ. of Stuttgart, Germany). pp II.6.1-II.6.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The input quantities of computer programs within the area of nuclear safety must often be considered as random quantities. From the knowledge of the input performance it is desired to draw conclusions about output performance (e.g.: distributions, confidence bounds, correlations). The application of Monte Carlo methods is introduced and the automatization of probabilistic analysis in program systems is described, based on the experiences in the frame of the modular systems RSYST and SSYST. Furthermore results for various types of nuclear reactor safety calculations are shown.

43061 Probabilistic analysis of rupture in nuclear reactor coolant piping. Harris, D.O. (Science Applications, Inc., Palo Alto, CA). pp II.7.1-II.7.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A methodology developed for calculation of pipe rupture probabilities is presented. This methodology uses fracture mechanics calculations of flaw growth, along with the initial defect size distribution and detection probabilities, to predict the probability of a pipe rupture. The techniques are then applied to the calculation of a complete pipe severance at a hot leg to pressure vessel joint in a typical pressurized water reactor. The effects of proof testing and code required inspection on the failure rate as a function of time are presented. The results show that the failure rate is a strong function of time and is not greatly affected by proof testing, but can be significantly reduced by in-service inspection.

43062 Probabilistic analysis of fire risks for the design of fire protection systems in nuclear power facilities. Webster, F.A.; Benjamin, J.R. (Engineering Decision Analysis Co., Inc., Palo Alto, CA). pp II.8.1-II.8.13 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper presents a complete probabilistic methodology for evaluating performance of fire protection systems (FPS) in nuclear power facilities. The methodology is based upon assuming a reasonable fire growth-suppression model which considers the entire spectrum of future events. The suppression effort, which is random, is a function of the FPS component performances and is modeled in terms of relevant component design parameters. The interaction of the suppression effort with the fire load is considered, as is the interaction of the fire load with the support structure. An example FPS is presented for illustration of the methodology, and several design-related problems are solved. Finally, a discussion of three Markov models which can be used in growth suppression problems is presented.

43063 CEA-sponsored research program on PWR reactor vessel failure probability calculation. Dufresne, J. (CEA/DSN, Fontenay-aux-Roses, France); Carnino, A.; Quero, J.; Grandemange, J.; Pellissier Tanon, A.; Lucia, A.C.; Elbaz, J. pp III.1.1-III.1.22 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The research program is directed by a joint committee involving Commissariat a l'Energie Atomique, Euratom and Framatome. The aim is to evaluate the probability of rupture of a Reactor Pressure Vessel (RPV), using Fracture Mechanics under probabilistic form. The methodology concerning data collection (defects, load, properties of material) and computational method is presented. The evaluation is focused on the welds of the Reactor Pressure Vessel (RPV). Size and distribution of defects will be obtained from a survey among European manufacturers: load and stresses are determined for operating transient which have been defined with their frequency or probability of occurrence. Fatigue crack propagation is computed using the Paris law with statistically determined coefficients. Toughness of the material is statistically determined taking into account temperature and fluence. An example of computation is presented, giving, for different sizes of an initial defect the probability of rupture during a LOCA taking into account the crack growth under 24 types of transient. To obtain the rupture probability of Reactor Pressure Vessel (RPV), this calculation must be completed to take into account the probability of having a defect of the given size and of having a loss of coolant accident (LOCA).

43064 Reliability of nuclear fuel. Misfeldt, I. (Risoe National Lab., Roskilde, Denmark). pp III.2.1-III.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

In nuclear reactors the fuel cladding yields the first protection against the release of radioactive products. The number of cladding failures must therefore be kept as low as possible. A computer program has been developed for the statistical analysis of the fuel performance. The statistical methods employed are either Monte Carlo simulations or a Taylor approximation. The program utilizes a deterministic fuel performance code and a stress corrosion failure criterion, verified against experimental data. The code has been applied to the analysis of irradiation experiments. The consequences (in form of failed fuel rods) for some minor accidents have been evaluated.

43065 Probabilistic method of calculating the effect of clad ballooning in a large bundle LOCA experiment. Argentesi, F.; Astolfi, M.; Mancini, G.; Olivi, L. (Commission of the European Communities, Ispra, Italy). pp III.3.1-III.3.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The application of Response Surface Methodology to a particular problem of Reactor Safety is described. An estimation is made of the possible blockage of a fuel bundle, during a LOCA, caused by coplanar ballooning of fuel pins. Various RSM alternatives are analyzed: estimation under different norms (L1, L2, L ∞), biased estimation, two classes of approximating functions (quadratic polynomials and inverse polynomials). Once the most suitable approximation has been defined, blockage sizes are calculated by an original probabilistic procedure invoking first the evaluation of the probabilities of ballooning at different axial levels of the pin and then the simulation of the ballooning events in the bundle by a Monte Carlo method. It is concluded that coherent blockage is unlikely to happen if ballooning is localized.

43066 Estimation of rain, typhoon and volcanic activity in the Philippines. Gilmore, J.J.; Tilford, N.R.; Gupta, I.N.; Wescott, R.G. (Ebasco Services Inc., New York, NY). pp III.4.1-III.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

An upper limit to the natural phenomena that may affect the safe operation of a nuclear power plant, including torrential rain, typhoon winds, and volcanic activity was required for the establishment of site characteristics to be utilized in the design of Philippine Nuclear Power Plant Unit 1 which is to be constructed on the west coast of Bataan Peninsula in the Republic of the Philippines. To establish reasonable upper bounds for these phenomena, procedures were adopted to utilize existing site and regional historical data and newly acquired data on geologic age of rock samples. It was also necessary to overcome such deficiencies in the available data which precluded use of certain procedures normally utilized for these studies in the United States. Although, many of the procedures utilized were similar to those employed in the United States, it was necessary to develop modified procedures to fit the region's meteorologic or geologic characteristics. The results of the studies performed enabled the Site Characteristics (Chapter 2) section of the Preliminary Safety Analysis Report to be prepared in compliance with applicable US Nuclear Regulatory Commission Regulatory Guides.

43067 SKIRON: a computer code for evaluating atmospheric dispersion for design basis accident analyses. Hamawi, J.N.; Laznow, J. (Yankee Atomic Electric Co., Westboro, MA). pp III.8.1-III.8.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

SKIRON is a computer code developed at Yankee Atomic Electric Company for implementation of the recent NRC (Nuclear Regulatory Commission) position on atmospheric dispersion conditions for design basis accident evaluations. The new position requires a probabilistic assessment of atmospheric dispersion and takes into consideration the varying site boundary distances of a nuclear power station and the varying wind direction frequencies. SKIRON also incorporates the features of Regulatory Guide 1.111 which provides guidance for estimating atmospheric dispersion of gaseous effluents in routine releases from light-water-cooled reactors. The code is comprehensive and includes the following basic features: use of hourly meteorological data; traight-line airflow model with Gaussian diffusion; plume centerline and sector-average models; distinct vertical and horizontal atmospheric stabilities; part-time ground level and

part-time elevated releases (split-H); terrain features; plume rise; building wake effects; and plume meander. A significant feature is the determination of certain effective gamma dilution factors which permit evaluation of external whole body doses from finite clouds of multi-energetic gamma sources.

43068 Probability of failure of a reactor pressure-tube in case of loss of coolant accident. Garribba, S. (Polytechnic Inst. of Milan, Italy). pp III.9.1-III.9.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The reliability of a Zr-2 pressure-tube to be installed in a D_2O-moderated BLWR is evaluated for the transient following LOCA. Reference is made to regions of pressure-tube wall where end effects and mechanical constraints have a negligible influence. Plastic instability is selected, as the criterion of failure. Overall reliability is the conditional probability (assuming the failure criterion and given a sample of experimental data) that applied stress does not exceed allowable strength in anyway. During LOCA pressure and temperature transients are represented in terms of stochastic processes non-stationary in time. The two processes are postulated statistically independent and their structure is defined according to a model of cumulated effects. On the other hand, since there is the need of considering all possible locations along the tube, mechanical properties and loads are described by means of stochastic processes supposedly stationary in space. The problem of stress vs. strength interference which ensues is simplified through the identification of a critical time instant. Then, overall reliability can be reduced to the calculation of space reliability. In an idealistic two-dimensional case, reliability is approximated by the probability of (zero-) level crossing of the sum of a number of stochastic processes. Finally, the concept of bayesian reliability may be established and a sample of new data (on material properties) can be worked out to calculate posterior distributions.

43069 Contribution of safety issues to public perceptions of energy systems. Otway, H.J.; Thomas, K. (International Inst. of Applied Systems Analysis (IIASA), Laxenburg, Austria). pp IV.1.1-IV.1.10 of Probabilistic analysis for nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Public opposition is an important consideration for those responsible for energy planning; however, the formulation of socially viable policies requires an understanding of the reasons for this opposition. An attitude model was applied to identify the underlying determinants of public perceptions of five energy systems: nuclear, coal, oil, solar and hydro. Empirical results (heterogeneous sample of the general public, N = 224) are reported in which these energy systems were found to be perceived in terms of four basic dimensions: psychological aspects; economic benefits; socio-political implications; environmental and physical safety issues. For the total sample, safety issues made an appreciable contribution to attitudes toward all of the systems except nuclear energy, where it was not significant. A differential analysis of two sub-samples, those respondents PRO and CON nuclear energy, showed that benefits and safety issues were important determinants of PRO attitudes while CON attitudes were primarily due to psychological aspects and concerns about personal and political power. The role of technical information in the formation of public attitudes toward technological policies is discussed.

43070 Value of life and nuclear design. Howard, R.A. (Stanford Univ., Palo Alto, CA); Matheson, J.E.; Owen, D.L. pp IV.2.1-IV.2.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Using the decision analysis framework, an implicit value of life can be determined for design decisions that have death as a possible outcome. A survey of the literature and calculations suggest a great inconsistency in the implied value of life. It is shown that by using a consistent, explicit value of life, the total expected number of deaths from all projects can be reduced without increasing total expenditures or reducing benefits. The explicit value of life directly affects design decisions. Some recent research indicates that the value that an individual places on his own life can be characterized by a few assessments of the individual's circumstances and his preferences.

43071 Discount rates for social cost benefit analysis of nuclear energy. Owen, P.A. (Stanford Univ., CA). pp IV.5.1-IV.5.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The question that this paper addresses is how decisions affecting many citizens should be made when there are uncertain outcomes in the distant future. By distant is meant beyond the lifetimes of individuals alive now. Thus the proposed methodology would apply to many decisions in nuclear energy from the investment in new energy sources such as fusion, to the long-term storage of wastes. Decisions of this type have usually been analyzed using cost benefit analysis. In this case, future outcomes are discounted at the so-called social discount rate. By comparison, the proposed methodology uses information on individual citizen's preferences and willingness to pay to make a future generation better off. The connection between the proposed approach and more traditional discounting techniques is examined using the government decision about storing helium for the future as an example.

43072 Occupational radiation standards based on morbidity risk. Tadmor, J. (Soreq Nuclear Research Centre, Yavne, Israel); Winkler, B.C.; Simpson, D.M. pp IV.6.1-IV.6.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The establishment of occupational radiation standards is investigated on the basis of morbidity risks expressly stated to be acceptable in other industries or human activities. A first attempt of comparing the tolerable radiation morbidity risk with that established as acceptable in the asbestos industry and industrial noise environments, indicates that the occupational radiation standard for the whole body and bone marrow should be of the order of 2 rem/a, and for the skin, 30 rem/a.

43073 Development of a probabilistic model of containment conditions following a core disruption accident in a breeder reactor. Peck, C.B. (General Electric Co., Sunnyvale, CA); Sultan, P. pp V.3.1-V.3.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Development of a probabilistic model for the evaluation of conditions in the containment of a breeder reactor following a core disruptive accident is discussed. The model as developed in the third phase of a risk assessment development program is presented. This model orders possible accident progression sequences, using various initial states, reaction modes and rates, and responses of engineered safety systems.

43074 Risk assessment methods application to the Fast Flux Test Facility. Feller, K. (General Electric Co., Sunnyvale, CA). pp V.4.1-V.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The technical approach and results of a risk assessment study based on the Fast Flux Test Facility reference design are summarized. The study was conducted as part of an ongoing effort to develop a technology base for breeder reactor risk assessment. The primary study objective was methods development. Due to the limited scope and lack of expert participation from many important technology areas, the results are not intended to represent the risk resulting from FFTF operation.

43075 AIPA-methodology reviewed, improved and applied to German HTGRs. Doehler, J.; Altes, J.; Ashworth, F.P.O. (Kernforschungsanlage Juelich GmbH (KFA), Germany). pp V.5.1-V.5.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The Institute of Nuclear Safety Research of the KFA Juelich reviewed the Accident Initiation and Progression Analysis carried out by the General Atomic Company with the aim to use it as the basis for a German HTR safety study. This paper deals with the results of this review, the improvements in the field of probabilistic analysis which are suggested to be applied to the German HTR safety study and their applications.

43076 Application of probabilistic analysis for comparison of post accident fuel containment schemes for a 300 MW(e) GCFR. Collins, T.E. (Dept. of Energy, Germantown, MD); Kelley, A.P. Jr. pp V.8.1-V.8.6 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Probabilistic risk methodology was applied to compare post accident fuel containment schemes for a 300 MW(e) Gas Cooled Fast Breeder Reactor design. Three options were examined: retention of molten debris within the primary vessel; retention outside the primary vessel but within secondary containment, and delayed

meltthrough into the earth below secondary containment. Relative risks from various modes of secondary containment failure were determined by combining off-site doses from a given failure with the likelihood of the physical processes leading to that failure. Each of the three options was then judged on the basis of its ability to retard or prevent the physical processes leading to secondary containment failure. It was determined that in-vessel retention and delayed meltthrough may provide comparable risk reduction, in-vessel retention schemes having the potential for the greater reduction and that retention outside the primary vessel but within secondary containment is the least desirable option.

43077 Failure data and risk analysis. Vesely, W.E. (Nuclear Regulatory Commission, Washington, DC). pp VI.1.1-VI.1.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The relationships between data analysis and risk analysis are described and their roles within a comprehensive data evaluations program are defined. The objectives of data analysis and risk analysis are laid out along with the input required and output produced. As a specific program for data evaluations, including utilizations of NPRDS data, the Reactor Safety Study is proposed as giving a reasonable framework for analyses and decision-making.

43078 Perspectives for a European Reliability Data System for light water reactors. Al, A.B.J.; Capobianchi, S.; Luisi, T. (Commission of the European Communities, Ispra, Italy). pp VI.2.1-VI.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This report summarizes the aim, the environment and the major problems concerning the development of a European Reliability Data System (ERDS) for L.W.R., based on the cooperation of the European countries. The more significant aspects of the project and the possible structure of the Data System are outlined here. The planning and progress of the whole project are also described, in particular as regards the setting up of two computerized pilot experiments: (1) an Event Data Bank (EDB), and (2) a Generic Source Reliability Data Bank (GSRDB).

43079 Statistical data processing for a safety data system. Colombo, A.G.; Jaarsma, R.J.; Olivi, L. (Commission of the European Communities, Ispra, Italy). pp VI.3.1-VI.3.13 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

In the nuclear field, confident figures about the reliability of components and systems are needed. Assuming that the failure parameter is a random variable, the paper proposes a single procedure for the estimation and the updating of the failure rate and the unavailability on demand. As inference method, a classical and a Bayesian approach are compared, and the influence of different prior distributions investigated. The propagation of the uncertainties of the failure probabilities at the various levels of complexity of a plant is also investigated, assuming an AND/OR fault-tree model. Finally, the Bayesian approach is proposed for estimation and updating of the failure parameter, and the gamma distribution is proposed as distribution to be used for describing the variability of the failure parameter.

43080 Application of James-Stein estimators in the evaluation of the Phenix reactor data bank. Dubau, J.; Koen, B.V.; Georgin, J.P. pp VI.4.1-VI.4.8 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The James-Stein estimators are used to evaluate failure rate data for the French fast breeder reactor operating components. A comparison with other estimators is also performed.

43081 Study on the quantification of judgment. Apostolakis, G.; Mosleh, A. (Univ. of California, Los Angeles). pp VI.5.1-VI.5.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The evaluation of probabilities of rare events in the context of the subjectivistic theory of probability is the subject of this work. Several useful subsidiary methods for the achievement of coherent probabilities are discussed with particular emphasis on experts' opinions. As an application, a distribution for the frequency of reactor core melts is assessed using the available experience with power reactors. This distribution is subsequently modified, via Bayes' theorem, to include the estimate derived by WASH-1400, which is treated as an expert's opinion. A probabilistic model for the credibility of this opinion is presented, which includes the critics' point of view. The resulting (posterior) distribution is the assessed distribution of the frequency of reactor core melts based on a body of knowledge which includes the available experience and the WASH-1400 estimate.

43082 Reactor safety impact of functional test intervals: an application of Bayesian decision theory. Buoni, F.B. (Florida Inst. of Tech., Melbourne). pp VI.6.1-VI.6.9 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Functional test intervals for important nuclear reactor systems can be obtained by viewing safety assessment as a decision process and functional testing as a Bayesian learning or information process. A preposterior analysis is used as the analytical model to find the preposterior expected reliability of a system as a function of test intervals. Persistent and transitory failure models are shown to yield different results. Functional tests of systems subject to persistent failure are effective in maintaining system reliability goals. Functional testing is not effective for systems subject to transitory failure; preventive maintenance must be used. A Bayesian posterior analysis of testing data can discriminate between persistent and transitory failure. The role of functional testing is seen to be an aid in assessing the future performance of reactor systems.

43083 Synthesis of experience data for risk assessment and design improvement of gas-cooled reactors. Hannaman, G.W.; Kelley, A.P. Jr. (General Atomic Co., San Diego, CA). pp VI.7.1-VI.7.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper illustrates the practical synthesis of previous component and system operating experience into the reliability parameters which are used in probabilistic risk evaluations of gas-cooled reactors (GCRs). Component and system reliability operating experience provides the basic input data for quantifying event tree and fault tree models that describe hypothesized reactor accident sequences. It is therefore necessary to collect and review the existing operating experience described in numerous accounts of power plant operations for both the development of detailed accident models and the quantification of their likelihood. It was found that the presently available operating experience includes enough information to provide both the qualitative and quantitative understanding necessary to evaluate the safety of the gas-cooled reactor designs.

43084 Availability analysis for some standby systems. Chu, B.B. (Electric Power Research Inst., Palo Alto, CA); Gaver, D.P. pp VI.8.1-VI.8.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The availability of two maintainable standby systems is studied. The first is a single-unit system that is periodically inspected and maintained. An optimum inspection interval is determined. The second is a three-unit inspected system patterned on a reactor on-site auxiliary power source. It is analyzed by stochastic process methods; numerical methods are used to describe availability under various failure and repair rate assumptions and inspection frequencies.

43085 Activities of the Commission of the European Communities and a critical review of quantitative concepts in risk assessment. Van Reijen, G.; Vinck, W. (Commission of the European Communities, Brussels, Belgium). pp VII.1.1-VII.1.16 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper gives a general survey of the activities of the Commission of the European Communities in hazard prevention. The second part describes the situation with regard to the application of quantitative risk concepts in nuclear and non-nuclear licensing processes. The paper concludes with a critical review of quantitative assessment and its use and with considerations in further development of the methodology.

43086 Role of risk criteria in nuclear plant decisions. McDonald, A.; Temme, M.I. (General Electric Co., Sunnyvale, CA). pp VII.2.1-VII.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Requirements for the determination of risk acceptance criteria are derived from reviews of past efforts related to their development and from social decision theory. It is observed that attempts to

objectively determine a definitive set of societal risk acceptance criteria cannot succeed because there is no objective procedure for aggregating the values and preferences of individuals into an expression that can be called society's preferences. The authors suggest that efforts be focused on determining maximum risk criteria (without the connotation of societal acceptance). Some thoughts on the proper role of such criteria are expressed, and the method of multiattribute utility theory for their determination is described in an example. It is also argued that it is particularly appropriate to define such standards for Breeder Reactors though it may not be so appropriate for LWR.

43087 Risk allocation approach to reactor safety design and evaluation. Gokcek, O.; Temme, M.I.; Derby, S.L. (General Electric Co., Sunnyvale, CA). pp VII.3.1-VII.3.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper describes a risk allocation technique used for determining nuclear power plant design reliability requirements. The concept of risk allocation-optimum choice of safety function reliabilities under a maximum risk constraint - is described. An example of risk allocation is presented to demonstrate the application of the methodology.

43088 Use of quantitative risk and probabilistic safety criteria in the conceptual design of a large pool-type LMFBR. Hartung, J.A.; Lancet, R.T. (Atomics International Div., Canoga Park, CA). pp VII.4.1-VII.4.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper describes how quantitative risk and probabilistic safety criteria have been used to supplement licensing regulations to guide the safety-related design of a large (1000 MWe) pool-type LMFBR.

43089 Balancing the safety of a gas cooled breeder reactor design by using the probabilistic and fault tree analysis method. Chermanne, J.; Dekais, J.J. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp VII.5.1-VII.5.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Extensive assessments of the safety of the 1,200 MWe commercial Gas Cooled Breeder Reactor reference design (GBR 4) were made using a method very similar to that reported in the WASH-1400 document. These studies were used to balance the design as far as engineered safeguards are concerned. Such a way to feed-back the safety information into the design has the advantage to avoid excessive redundancy in some systems and therefore tends to limit the plant cost. The study demonstrates, for example, the need of introducing an inherent-fuse actuated system which otherwise would have been considered as penalizing the cost of the reactor by introducing extra redundancy.

43090 Design stage probabilistic assessment of prototype LMFBR safety systems. Kondo, S.; Togo, Y. (Univ. of Tokyo, Japan). pp VII.6.1-VII.6.20 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Probabilistic assessment has been applied to the design of prototype liquid metal cooled fast breeder reactor safety systems. Natural convection cooling or sufficient length of allowable outage time has been found to be the most desirable feature for assuring high availability of the decay heat removal system. The allowable outage time has been evaluated from probabilistic point of view, and it has been found that large temperature margin is required to determine it due to the uncertainty in the decay heat curve and in the friction factor for fluid flow. For safe shutdown system, several designs of rod drive mechanism as well as structure of logic train have been compared from the reliability viewpoint. Highly reliable shutdown capability has been obtained by the combination of two independent systems. Some discussion has been devoted to the effect of grouping of instrument channels sets, cross-linking, and the reliability under the earthquake condition.

43091 Probabilistic approach to safety assessment and design optimization of two PWR safety related systems (SIS and AFWS). Portal, R.; Villemeur, A. (Electricite de France, Clamart). pp VII.7.1-VII.7.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Reliability studies of the Auxiliary Feedwater System (AFWS) and the Safety Injection System (SIS) are given as examples of probabilistic safety studies undertaken by Electricite de France. The reliability of the AFWS and SIS of a Pressurized Water Reactor plant in actual operation, the FESSENHEIM plant, is thoroughly studied both qualitatively and quantitatively. The results of these reliability studies which were carried out for the FESSENHEIM plant are being used in the design of the AFWS and SIS of the stations, construction of which has begun or is planned.

43092 Use of fault tree analysis in the design of the Westinghouse microprocessor based Reactor Trip Logic System. Cook, B.M. (Westinghouse Electric Corp., Pittsburgh, PA). pp VII.8.1-VII.8.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Westinghouse has redesigned the protection system for their pressurized water reactor systems with the goals of updating the technology of the system and lessening the impact of protection system failures on plant availability. In order to maintain a high degree of protection system reliability, reliability studies have been conducted throughout the design phase. In particular, fault tree analysis was used to determine various aspects of the architecture of the Reactor Trip Logic System. The result of this design approach is a system which virtually eliminates spurious plant trips caused by failures within the protection system and yet is as reliable as the reactor trip system currently provided in Westinghouse pressurized water reactor plants.

43093 Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978). 524p. (CONF-780507—P3). $42.00 (3 Vol. set).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Separate abstracts were prepared for the individual papers included.

43094 Fault tree analysis of multistate systems with multistate components. Caldarola, L. (Kernforschungszentrum Karlsruhe GmbH, Germany). pp VIII.1.1-VIII.1.28 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A general analytical theory has been developed, which allows one to calculate the occurrence probability of the top event, the transition intensity to the top event of a fault tree and the transition intensity between two states of a multistate system. Results are simple and applicable to coherent as well as to noncoherent systems made of binary (two states) as well as multistate components. Important features of the method are the identification of the smallest disjunctive form of a boolean function, the use of a new simple equation for the calculation of the transition intensity to the top event and the use of a simple equation for the calculation of the transition intensity between two states of a multistate system. The theory accounts also for a good and correct mathematical treatment of dependent failures of components.

43095 Evaluation of the reliability and the availability of large repairable systems by the method of critical running states. Pages, A. (Electricite de France, Clamart); Gondran, M.; Magnon, B. pp VIII.2.1-VIII.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

In this paper we present the calculation by an analytical method of a good approximation of large repairable systems reliability. We first establish the relation existing between the failure rate of a system and the quotient failure intensity to availability in the case of repairable systems; this allows us to present another approach of the method suggested by VESELY, which facilitates generalizations to dependent elements and makes the designer analysis task easier. We also present the example of reliability computation relative to the 6,6 kV electrical power supply system of the 900 MW Fessenheim PWR plant.

43096 Automated merging of Markov processes of large reactor systems. Papazoglou, I.A.; Gyftopoulos, E.P. (Massachusetts Inst. of Tech., Cambridge). pp VIII.3.1-VIII.3.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A technique is presented for reducing the computational effort in calculating the reliability of certain systems described by Markov processes. It is shown that Markov processes describing systems with symmetries are mergeable and a systematic method for

achieving the merging is developed. Based on this method a computer code has been written that performs the merging and generates the transition probability matrix of the merged process.

43097 Role of distributed microscopic physical phenomena in probabilistic accident analysis with deterministic codes. Abramson, P.B.; Hummel, H.H.; Gelbard, E.M.; Pizzica, P.A.; Sienicki, J.J. (Argonne National Lab., IL). pp VIII.4.1-VIII.4.13 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Analysis of Hypothetical Core Disruptive Accidents with large computer codes is based upon the assumption that enough basic physical information is available to enable the analyst to write down the proper analytical description of these processes and that macroscopic behavior will be properly calculated as an end product. The thermodynamic and hydrodynamic processes that go on during such a disrupted state analysis are dependent upon the geometry and flow regime, which are unknown and not deterministically predictable with any ease. Thus analysts have associated variable parameters with these processes and the sensitivity of macroscopic results to the microscopic parameters has been examined by studying the response function of a straight through calculation to a different parametric value. However, the processes depend upon functions which are distributed rather than single valued. Analysis which adds in the information about the distributed nature of the microscopic processes reduces the sensitivity of the macroscopic result to the microscopic parameter.

43098 Problems of rare events in the reliability analysis of nuclear power plants. Carnino, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France); Royen, J.; Stephens, M. (eds.). pp VIII.5.1-VIII.5.24 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Comprehensive reliability analyses of nuclear power plants must include an estimate of the significance of rare events (that is, those with very low probability of occurrence) having the potential to seriously compromise the system integrity. In 1976 a multinational, multidisciplinary Task Force of reliability specialists was set up under the sponsorship of the Committee on the Safety of Nuclear Installations of the OECD Nuclear Energy Agency, to characterize the contributing factors and assemble appropriate mathematical techniques to treat this instance of the rare event problem. Component reliability data from several countries have been collected on electrical and sensing systems, control rod actuating and mechanical systems, valves, and mechanical components of reactor safety systems.

43099 Tornado missile simulation and risk analysis. Twisdale, L.A. (Carolina Power & Light Co., Raleigh, NC); Dunn, W.L.; Chu, J. pp VIII.6.1-VIII.6.15 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Mathematical models of the contributing events to the tornado missile hazard at nuclear power plants have been developed in which the major sources of uncertainty have been considered in a probabilistic framework. These models have been structured into a sequential event formalism which permits the treatment of both single and multiple missile generation events. A simulation computer code utilizing these models has been developed to obtain estimates of tornado missile event likelihoods. Two case studies have been analyzed; the results indicate that the probability of a single missile from the sampling population impacting any of the plant's targets is less then about 10^{-7} per reactor-year. Additional work is needed for verification and sensitivity study.

43100 Probabilistic evaluation of risks associated with aviation, road, railway and river traffic adjacent to nuclear power plants in France. Procaccia, H. (Electricite de France, Saint-Denis); Gobert, T. pp VIII.7.1-VIII.7.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Electricite de France has developed a methodology to calculate the potential impact of risks to a nuclear power plant subsequent to an accident occurring on transportation networks in the vicinity of a nuclear site. Risks entailed in aviation, and in road, rail, and river traffic have been estimated. This methodology has been applied to all sites planned in France.

43101 Estimation of nuclear power plant aircraft hazards. Gottlieb, P. (Dames & Moore, Los Angeles, CA). pp VIII.8.1-VIII.8.8 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The standard procedures for estimating aircraft risk to nuclear power plants provide a conservative estimate, which is adequate for most sites, which are not close to airports or heavily traveled air corridors. For those sites which are close to facilities handling large numbers of aircraft movements (airports or corridors), a more precise estimate of aircraft impact frequency can be obtained as a function of aircraft size. In many instances the very large commercial aircraft can be shown to have an acceptably small impact frequency, while the very small general aviation aircraft will not produce sufficiently serious impact to impair the safety-related functions. This paper examines the in between aircraft: primarily twin-engine, used for business, pleasure, and air taxi operations. For this group of aircraft the total impact frequency was found to be approximately once in one million years, the threshold above which further consideration of specific safety-related consequences would be required.

43102 Potential for the reduction of core melt probability. Epler, E.P. (Oak Ridge Associated Universities, TN). pp X.1.1-X.1.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Any substantial reduction in core melt probability would require extensive backfitting or retirement of the nearly 100 LWRs now, or soon to be in operation. This is not likely to be accomplished during this century. Inasmuch as public acceptance is conditioned on consequences rather than probabilities, there is little reason to believe that public acceptance would be enhanced by a further reduction in core melt probabilities. On the other hand, an early core melt could do much to destroy existing acceptance. Existing systems for residual heat removal depend on defense in depth using general purpose systems, which in turn depend on operator performance. An examination of current operating experience leads to the conclusion that a dedicated system for residual heat removal is needed, but for the short term, a different program is suggested which would need to be implemented without delay.

43103 Fault tree analysis incorporating dependent events. Rumble, E.T.; Olmos, J. (Science Applications, Inc., Palo Alto, CA). pp X.4.1-X.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A direct method of incorporating initiator events with varying potential damage intensities into fault trees is described. This method is applicable to modeling external events and provides inclusion of the complete intensity ranges of the events considered. The resultant cumulative intensity dependent model requires availability data conditional on the event being described. An example considering earthquakes shows the method to be of general use and consistent with present quantification techniques. The shape of the frequency versus intensity function is seen to have a strong influence on the event's unavailability contribution.

43104 Common mode analysis of valve leakages. Johnson, J.W.; Vesely, W.E. (Nuclear Regulatory Commission, Washington, DC). pp X.5.1-X.5.8 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A Marshall-Olkin based approach is applied to estimate common mode probabilities of valve leakages. The application utilizes recorded failure data to estimate the common mode probabilities and thus serves as an example of the utilization of current data sources in identifying and quantifying common mode failure probabilities.

43105 Common cause failure experience for reliability analysis and design guidelines in large nuclear breeder plants. Edison, G.E. (Westinghouse Electric Corp., Madison, PA). pp X.6.1.-X.6.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Failure experience in all PWR auxiliary feedwater systems (AFWS) was reviewed for calendar 1975. Common cause failures (CCF) were examined in detail. An identification/classification scheme was developed for CCF's. Common mode failures were regarded as a special sub-class of CCF. The PWR experience indicated that about one out of four failures in the AFWS was a CCF. Most of the CCF's did not cause a significant loss of availability of the AFWS. System failures dominated the CCF's while hardware failures dominated non-CCF's. Design inadequacies were the most frequent cause of CCF's. A strong systems integration effort in the design stage of large breeder reactors is recommended to help avoid

CCF's. A number of CCF's involved the failure to assure the required supply of condensate water to the AFWS pumps according to technical specifications. Increased design attention to this part of the AFWS is recommended for large breeder plants. Numerous other recommendations are included.

43106 Structural reliability of reactor systems. Rackwitz, R.; Krzykacz, B. (Tech. Univ. of Munich, Germany). pp X.8.1-X.8.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Reliability analysts working on reactor systems should be concerned with common mode failure. Component or mode failures then are dependent events. The analytical and numerical tools for realistic system reliability assessments in those cases are still not yet fully developed. The well-known lower or upper reliability bounds are only poor guides for optimal design decisions, particularly, if there is a large number of potential failure modes. Therefore, an alternative formulation within the framework of so-called first order reliability methods is presented. It allows the approximate determination of component reliabilities by a local transformation of non-normal basic uncertainty vectors into normal vectors and by local linearization of arbitrary mechanical failure criteria. Component reliabilities then are simply the values of the univariate normal integral with the so-called safety index being the argument. Due to the stochastic dependence of the different modes of failure, the calculation of system reliabilities requires the evaluation of multinormal probabilities, instead. Some numerical methods for their evaluation are given. Finally, the method is applied to Markovian systems the states of which are defined by sets of components or subsystems having either failed or survived. The presentation concentrates on the mathematical concepts and solution techniques rather than on direct practical application.

43107 Probabilistic analysis of systems related to PWR safety: synthesis of EDF studies. Llory, M. (Electricite de France, Clamart); Gachet, B. pp XII.3.1-XII.3.13 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A brief resume of how Electricite de France organized its working program on probabilistic studies is presented and the methodology used in the reliability analyses is described. The probabilistic approach to safety systems can be broken down into five essential phases, the essential elements of which are: a critical review of the available information on the system under study; qualitative reliability analysis by the fault-tree method; the search for common-mode failures; quantitative analysis and synthesis of results, leading to proposals for optimizing the system and its operating rules. The principal results obtained, together with the specific conclusions drawn from the study on safety systems in PWR nuclear power plants are presented.

43108 Validation of the probabilistic approach for the analysis of PWR transients. Amesz, J. (Joint Research Centre, Ispra, Italy); Francocci, G.F.; Clarotti, C. pp XII.4.1-XII.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper reviews the pilot study at present being carried out on the validation of probabilistic methodology with real data coming from the operational records of the PWR power station at Obrigheim (KWO, Germany) operating since 1969. The aim of this analysis is to validate the a priori predictions of reactor transients performed by a probabilistic methodology, with the posteriori analysis of transients that actually occurred at a power station. Two levels of validation have been distinguished: (a) validation of the rate of occurrence of initiating events; (b) validation of the transient-parameter amplitude (i.e., overpressure) caused by the above mentioned initiating events. The paper describes the a priori calculations performed using a fault-tree analysis by means of a probabilistic code (SALP 3) and event-trees coupled with a PWR system deterministic computer code (LOOP 7). Finally the principle results of these analyses are presented and critically reviewed.

43109 Utility assessment of the high pressure/low pressure safety injection interface. Jeffries, J.D.E. (Carolina Power & Light Co., Raleigh, NC). pp XII.5.1-XII.5.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The Reactor Safety Study (RSS), WASH-1400, and a later EPRI Report identified and analyzed the potential risks associated with the loss of barriers between interconnecting high pressure/low pressure systems. Specifically, the boundary between the reactor coolant system (RCS) and the low pressure safety injection system (LPSI) was identified as having the potential to lead to a core meltdown and a subsequent release of radiation to the environs. The probabilities of barrier failure were calculated in WASH-1400 along with a note that the results could be reduced by at least an order of magnitude with the adoption of a periodic test program. Based on this information, the NRC specified three options considered acceptable to mitigate the risks associated with this interface problem; these options were promulgated in Section 6.3 of the Standard Review Plan, NUREG-75/087. EPRI later published a report showing that, from a probabilistic view, the NRC's options were quite different, with actual values ranging from approximately 10^{-5} to 10^{-9} failures per reactor year. The purpose of this paper is to assess the results of both WASH-1400 and the EPRI report and determine the acceptability of specific operational and planned low pressure injection systems. Differences between the systems analyzed and those in operation or design are highlighted and quantified. Conclusions which address the merit of this type methodology are also presented.

43110 Impact of component outages on ECCS/ECI unavailability. Powers, J.T.; Liner, R.T.; Lofgren, E.V. (Science Applications, Inc., McLean, VA). pp XII.7.1-XII.7.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A general methodology has been developed which provides a quantitative basis for setting Limiting Conditions of Operation (LCO) governing Emergency Core Cooling System (ECCS) component outages. The analysis represents an extension of the techniques of the Reactor Safety Study and specifically addresses scheduled test and non-routine maintenance outages which impact the unavailability of the Emergency Coolant Injection (ECI) mode of the ECCS. The methodology can provide a basis for limiting both the short-term effects of outages, in terms of conditional unavailability constraints, and the long-term effects, measured by the average state of the system over a time interval. The methodology is not meant to replace engineering judgement in establishing LCOs, but to provide a framework for its application. No attempt has been made to optimize LCOs, nor are any specific recommendations made for establishing them, either directly or in terms of criteria. The objective is to present a possible approach and to demonstrate the viability of the probabilistic risk analysis methodology in addressing a specific problem in the licensing and regulatory decision-making process.

43111 Reliability of dc power supplies in nuclear power plant application. Eisenhut, D.G. (Nuclear Regulatory Commission, Washington, DC). pp XII.8.1-XII.8.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

In June 1977 the reliability of dc power supplies at nuclear power facilities was questioned. It was postulated that a sudden gross failure of the redundant dc power supplies might occur during normal plant operation, and that this could lead to insufficient shutdown cooling of the reactor core. It was further suggested that this potential for insufficient cooling is great enough to warrant consideration of prompt remedies. The work described herein was part of the NRC staff's efforts aimed towards putting the performance of dc power supplies in proper perspective and was mainly directed towards the particular concern raised at that time. While the staff did not attempt to perform a systematic study of overall dc power supply reliability including all possible failure modes for such supplies, the work summarized herein describes how a probabilistic approach was used to supplement our more usual deterministic approach to reactor safety. Our evaluation concluded that the likelihood of dc power supply failures leading to insufficient shutdown cooling of the reactor core is sufficiently small as to not require any immediate action.

43112 SALP (Sensitivity Analysis by List Processing), a computer assisted technique for binary systems reliability analysis. Astolfi, M. (Joint Research Centre, Ispra, Italy); Mancini, G.; Volta, G.; Van Den Muyzenberg, C.L.; Contini, S.; Garribba, S. pp XIII.1.1-XIII.1.15 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A computerized technique which allows the modelling by AND, OR, NOT binary trees, of various complex situations encountered in safety and reliability assessment, is described. By the use of list-processing, numerical and non-numerical types of information are used together. By proper marking of gates and primary events, stand-by systems, common cause failure and multiphase systems can be analyzed. The basic algorithms used in this technique are shown

in detail. Application to a stand-by and multiphase system is then illustrated.

43113 Multiple-valued logic in modeling of nuclear safety systems and automated search for fault states. Contini, S. (SIGEN, Cologno Monzese, Italy); Fumagalli, S.; Mussio, P.; Naldi, F.; Garribba, S.; Volta, G. pp XIII.2.1-XIII.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The work shows how multiple-valued logic can be applied to reliability analysis of nuclear safety systems. Foundations of methods are provided and solutions are given for two selected practical cases. A formal procedure of decomposition-recomposition allows the construction of the multiple-valued logical tree (MVLT) of the system. MVLT can be analyzed directly or reduced to an equivalent forest of binary logical trees. Merits of MVLT are better control of information to retain in the representation of the tree, high degree of compactness, possibility of testing directly the effect of changes in the structure of the system itself. Steps needed for system reliability analysis and search for fault states are implemented by computer programs.

43114 FAUNET: a program package for fault tree and network calculations. Platz, O.; Olsen, J.V. (Risoe National Lab., Roskilde, Denmark). pp XIII.3.1-XIII.3.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A program package for fault tree and network calculations is described. The package contains an algorithm for modularization of fault trees prior to the calculation of the minimal sets. For many fault trees the modularization will reduce the number and/or the order of the minimal sets so much that it becomes possible to perform exact probability calculations instead of using bounding techniques. A reduction-expansion algorithm for this purpose is described. The failure intensity formula for maintained systems derived by Murchland is shown to be particularly well suited for implementation in connection with the modularization.

43115 PL-MOD: a computer code for modular fault tree analysis and evaluation. Olmos, J. (Science Applications, Inc., Palo Alto, CA); Wolf, L. pp XIII.4.1-XIII.4.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The computer code PL-MOD has been developed to implement the modular methodology to fault tree analysis. In the modular approach, fault tree structures are characterized by recursively relating the top tree event to all basic event inputs through a set of equations, each defining an independent modular event for the tree. The advantages of tree modularization lie in that it is a more compact representation than the minimal cut-set description and in that it is well suited for fault tree quantification because of its recursive form. In its present version, PL-MOD modularizes fault trees and evaluates top and intermediate event failure probabilities, as well as basic component and modular event importance measures, in a very efficient way. Thus, its execution time for the modularization and quantification of a PWR High Pressure Injection System reduced fault tree was 25 times faster than that necessary to generate its equivalent minimal cut-set description using the computer code MOCUS.

43116 Automated preliminary risk analysis (AUTOET II). Wilson, J.R. (EG & G Idaho, Inc., Idaho Falls). pp XIII.5.1-XIII.5.6 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

AUTOET II is a computer code which automatically draws a system event tree, eliminating unnecessary branches, and lables each accident sequence with probability, consequences and risk. The inputs to the code are key subsystems, cut sets (on a subsystem basis), consequences of subsystem failure in each failure mode, and initiating event probability.

43117 Computer code for fault tree calculations: PATREC. Blin, A. (Commissariat a l'Energie Atomique-CEN, Fontenay-aux-Roses, France); Carnino, A.; Koen, B.V.; Duchemin, B.; Lanore, J.M.; Kalli, H.; Hervy, A.; Jubault, G. pp XIII.6.1-XIII.6.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

A computer code for evaluating the reliability of complex system by fault tree is described in this paper. It uses pattern recognition approach and programming techniques from IBM PL1 language. It can take account of many of the present day problems: multi-dependencies treatment, dispersion in the reliability data parameters, influence of common mode failures ... The code is running currently since two years now in Commissariat a l'Energie Atomique Saclay center and shall be used in a future extension for automatic fault trees construction.

43118 Comparison of results from the GO methodology and fault tree analysis. Wood, D.E. (Kaman Sciences Corp., Colorado Springs, CO); Pittman, J.W. pp XIII.7.1-XIII.7.11 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The GO methodology and fault tree analysis techniques for reliability analysis were used to model the electrical portion of a reactor trip system. The models were prepared independently after agreement on the problem boundary and data base. Results for the probability of removal of control rod holding power on trip demand were compared for single and multiple parameter trips, with and without maintenance. Minimal cut sets of second order were determined for the fault tree and sensitivities were calculated for components in the GO model. The study was intended to demonstrate the overall capabilities, features and limitations of the GO methodology and to introduce the methodology to NRC as an additional analytical resource. The numerical results were intended to be used for the methodology comparison rather than as an accurate reliability evaluation of the Reactor Protection System. Both methods produced the same results when minor differences in modelling were reconciled. The GO results included higher order failures which were significant only for single parameter trips. Intermediate event probabilities and sensitivities for all component kinds were computed from the GO model.

43119 Seismic reliability of nuclear power plants. Cornell, C.A. (Massachusetts Inst. of Tech., Cambridge); Newmark, N.M. pp XIV.1.1-XIV.1.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Analysis of nuclear power plant safety with respect to severe seismic initiating events is receiving much current attention. The role of the structural and mechanical engineer becomes very strong in such a study relative to his role in operational accident analyses. This paper summarizes the spectrum of approaches that have been used to date. It concludes with a brief presentation of a methodology which lies at an intermediate level in that spectrum and which use concepts from the probability theory of both events and random variables. We stress the importance of learning how best to construct such coarser (but more transparent) models from the experience obtained from the more detailed, involved studies.

43120 Evaluation of the incremental seismic risk due to the presence of nuclear power plants. Lee, Y.T.; Okrent, D.; Apostolakis, G. (Univ. of California, Los Angeles). pp XIV.2.1-XIV.2.12 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The seismic risk for the continental United States, in terms of the expected annual number of deaths and severe injuries, and the expected property damage, is evaluated in this work. Probabilistic models and correlations are developed and used in the evaluations of the risks, accounting for such important variables as the variability of property values, damage factors, and so on. In addition, the incremental seismic risk due to the presence of nuclear power plants is evaluated utilizing results and methods available in the literature. The results show that the incremental risk is generally very small compared to the background seismic risk, even if a very high probability for core melt is postulated.

43121 Method for seismic acceleration assessment with an application to the Western US. Bloom, E.D.; Erdmann, R.C. (Science Applications, Inc., Palo Alto, CA). pp XIV.3.1-XIV.3.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

This paper presents a technique for using local seismic history to determine expected maximum site accelerations from earthquake events in the surrounding region. This method is based upon an invariant seismic frequency-magnitude shape for each section of the encompassing region. An application of this method to a set of locations in the Western US is presented.

43122 Application of probabilistic techniques to seismic risk analysis on the Diablo Canyon Plant. Brunot, W.K.; Fray, R.R.; Gillespie, S.G.; Moulia, T.A.; Price, R.E.; Shaw, H.C. (Pacific Gas and Electric Co., San Francisco, CA). pp XIV.5.1-XIV.5.10 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The principal purpose of this study was to make an assessment of potential risks to the public from earthquake-caused accidents at the Diablo Canyon Nuclear Power Plant. Since large earthquakes are relatively rare events at any given location and nuclear power plants are required to be designed to high standards of strength, such studies deal inevitably with small probabilities determined from combinations of rare events. Some of the methods used in the study were based on those used in the Reactor Safety Study, a recent comprehensive study conducted by the Nuclear Regulatory Commission for nuclear plants of the Diablo Canyon type. In this study, which was specifically devoted to risks from earthquakes, all the data and conditions used were based on those applicable to the Diablo Canyon Plant and site characteristics. Among other results, it was found that even when considering the impact on the plant of accelerations well in excess of the maximum which the NRC has asked the company to consider, the risk to the health and safety of the public caused by possible earthquake damage to the plant was found to be extremely remote. As an illustration, the probability of an individual in the closest community to the site being exposed to as much as 25 Rem of radiation to the whole body is only about one in seven million per year.

43123 Diablo Canyon seismic response utilizing logic models to determine plant response to external events. Leverenz, F.L. (Science Applications, Inc., Palo Alto, CA); Kelly, J.E.; Moulia, T.A.; Fray, R.R. pp XIV.4.1-XIV.4.8 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Based upon fault tree techniques developed for the Electric Power Research Institute, a seismic risk assessment was performed for a reactor located in the Western United States. The fault and event tree analysis on that task is briefly described herein. Overall risk assessment for the project was performed by Pacific Gas and Electric Corporation and most of the related stress and component failure analysis was done by their staff or in cooperation with them.

43124 Gravitational agglomeration of post-HCDA LMFBR aerosols. Pertmer, G.A. Columbia, MO; Univ. of Missouri (1978). 256p. University Microfilms Order No. 7906908.

Thesis (Ph. D.).

A Hypothetical Core Disruptive Accident (HCDA) in an LMFBR may release a very complex and radioactive aerosol into the primary containment atmosphere. After release, the aerosol particles will settle and there will be particle-particle collisions. Coagulation between the particles leads to the formation of a third, larger aerosol particle. The coagulation process of aerosols is stipulated to be composed of three separation mechanisms - Brownian, turbulent, and gravitational coagulation. This dissertation is concerned only with gravitational coagulation, which occurs due to the differential settling velocities of two aerosol particles. Results are presented for the calculation of the gravitational collision efficiency for various conditions. Both constant density and size dependent density aerosol particles are analyzed. The larger particle radius is varied from 0.5μ to 100μ, and appropriate drag force terms are utilized. Also, since the containment atmospheric properties may vary during the course of an accident, the effect on ϵ of changing the fluid properties is investigated. The results show that both the particle size and density have a strong effect on the gravitational collision efficiency. In general, it is difficult to construct a simple representation of ϵ as a function of these variables.

ACCIDENT LIABILITY

43125 Insurance and catastrophic events: can we expect de facto limits on liability recoveries. Solomon, K.A. (Rand Corp., Santa Monica, CA); Whipple, C.; Okrent, D. pp IV.7.1-IV.7.14 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The purpose of this study is to take an overview of large technological systems in society to ascertain the prevalence, if any, of situations that can lead to catastrophic effects where the resultant liabilities far exceed the insurances or assets subject to suit in court, thereby imposing de facto limits on liability recoveries. In part, interest in this topic is spurred by the continuing discussion and controversy over the Price-Anderson Act which requires operators of nuclear plants to waive certain defenses and which limits the combined liability of the operator and the government to an amount less than the maximum potential public cost of a major nuclear reactor accident. A variety of technological events could result in assignable liabilities up to $25 billion, or more, depending on the value of life. These postulated events include: (1) the crash of a large aircraft into a crowded sports facility (an estimated $20.3 billion liability); (2) an explosion and subsequent dispersion of a chemical (such as chlorine or LNG) into a population center from a large manufacturing, storage, or transport facility (estimated $25.5 billion liability); (3) a massive nuclear power plant accident and the subsequent dispersal of large quantities of radioactive material to a large downwind population center ($25 billion liability); (4) the collision of two ships, such as a large LNG tanker and a large passenger liner, resulting in the deaths of all passengers on board ($5.5 billion liability); and (5) collapse of a large building in an earthquake, known by the owners to be seismically deficient and no steps having been taken to warn occupants or to remedy the situation (major deficiencies). All these events are found to involve potential liability far exceeding the available resources, whether they be insurance, corporation assets, or government revenues.

ENERGY STORAGE

MAGNETIC

REFER ALSO TO CITATION(S) 43146

43126 (CONF-781046—, pp 238-245) **Superconductive diurnal energy storage studies.** Boom, R.W. (Univ. of Wisconsin, Madison). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A general description of a large central energy storage unit employing superconducting magnet technology is presented. Work on this concept has been under way at the University of Wisconsin since 1970. Economic and engineering optimization has shown that a superconducting energy storage magnet system would be competitive with other storage schemes for units larger than 1000 MWh. The device consists of a large superconducting magnet of approximately 100 m radius interfaced with the power system with a three-phase Graetz bridge. Economic analysis dictates that the magnet be a single layer segmented solenoid buried in bedrock and operated in super-fluid helium. An overall discussion of progress on the Wisconsin project is presented including recent cost estimates and time schedule for commercialization of the technology.

43127 (CONF-781046—, pp 247-252) **Recent component development studies for superconductive magnetic energy storage.** Van Sciver, S.W. (Univ. of Wisconsin, Madison). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

For the past two years the Wisconsin Superconductive Energy Storage project has been in the component development phase. Work during this period has been principally directed toward development of the superconducting composite conductor and the fiber reinforced strut needed to transfer the loads from the magnet to the bedrock structure. Conductor work has involved design as well as research into manufacturing techniques suitable for mass production. In a related activity, heat transfer studies in super-fluid helium has shown potential for substantially better conductor stability than occurs in normal helium. Compressive testing of fiber reinforced composite materials has been employed to evaluate the commercially available products. A current survey of progress in the component development studies at Wisconsin provides the main content of the present paper. The direction of future activities is also discussed.

43128 (CONF-781046—, pp 254-262) **Power system stability using superconducting magnetic energy storage: dynamic characteristics of the BPA system.** Cresap, R.L.; Hauer, J.F. (Bonneville Power Administration, Portland, OR). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Modulation of the Pacific HVDC Intertie has shown that a small amount of control can provide damping for the western system, which has a history of negatively damped oscillations. Because an extended outage of the DC Intertie could reduce the capability of the AC Intertie an alternate source of damping is desirable. This could be done with a small special-purpose SMES unit. In order to establish the size of the unit, field tests were conducted to determine the dynamic characteristics of the western

system. Analysis of the data indicates that, under normal operating conditions, a 10-MW device would provide damping equivalent to dc modulation.

43129 (CONF-781046—, pp 264-269) **Hybrid computer study of an SMES unit for damping power system oscillations.** Krause, P.C.; Triezenberg, D.M. (Purdue Univ., West Lafayette, IN). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The work conducted at Purdue University regarding the use of SMES to damp oscillations in the BPA system is reported. This investigation was conducted in parallel with work at LASL and BPA and serves as a verification of the work at BPA. In particular, the dynamic characteristics of the BPA system were simulated on the hybrid computer using the response obtained from the Chief Joseph Dynamic Brake test. The SMES unit was simulated using information supplied by LASL. The compensator was simulated using the design developed by BPA. The hybrid computer study illustrates the dynamic response of the BPA system with the SMES unit in service for sinusoidal variations in AC Intertie power and for random variations of AC Intertie loading.

43130 (CONF-781046—, pp 272-282) **Superconducting magnetic energy storage.** Rogers, J.D.; Boenig, H.J. (Los Alamos Scientific Lab., NM). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Superconducting inductors provide a compact and efficient means of storing electrical energy without an intermediate conversion process. Energy storage inductors are under development for diurnal load leveling and transmission line stabilization in electric utility systems and for driving magnetic confinement and plasma heating coils in fusion energy systems. Fluctuating electric power demands force the electric utility industry to have more installed generating capacity than the average load requires. Energy storage can increase the utilization of base-load fossil and nuclear power plants for electric utilities. Superconducting magnetic energy storage (SMES) systems, which will store and deliver electrical energy for load leveling, peak shaving, and the stabilization of electric utility networks are being developed. In the fusion area, inductive energy transfer and storage is also being developed by LASL. Both 1-ms fast-discharge theta-pinch and 1-to-2-s slow tokamak energy transfer systems have been demonstrated. The major components and the method of operation of an SMES unit are described, and potential applications of different size SMES systems in electric power grids are presented. Results are given for a 1-GWh reference design load-leveling unit, for a 30-MJ coil proposed stabilization unit, and for tests with a small-scale, 100-kJ magnetic energy storage system. The results of the fusion energy storage and transfer tests are also presented. The common technology base for the systems is discussed.

43131 (CONF-781046—, pp 284-289) **Superconducting magnetic energy storage for power system stability applications.** Chowaniec, C.R.; Stiller, P.H. (Westinghouse Electric Corp., East Pittsburgh, PA). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Superconducting magnetic energy storage (SMES) devices are characterized in terms of reasonable power and total energy ratings as well as other pertinent specifications. The objective of this investigation was to seek possible applications for small SMES devices in power systems, particularly as stability aids. Small SMES devices are those which are not large enough to be practical as bulk energy storage units. The suitability of the SMES device as an aid to maintaining power system stability is discussed in light of the anticipated capabilities of the device. Possible application of the SMES device as a guard against subsynchronous resonance is also considered.

COMPRESSED GAS

REFER ALSO TO CITATION(S) 43146, 43207

43132 (CONF-781046—, pp 333-336) **Compressed air energy storage program overview.** Loscutoff, W.V. (Battelle Pacific Northwest Labs., Richland, WA). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The DOE compressed air energy storage (CAES) program consists of a group of interrelated studies directed at developing a new technology to improve the cost and efficiency of electrical power utilization. The program has two major thrusts -- Reservoir Stability Criteria Studies and Advanced Concepts Studies. The Reservoir Stability Criteria Studies are aimed at accelerating the near-term application of conventional systems. The Advanced Concepts Studies are directed at development of systems that require little or no firing of the turbines with premium fuels. The Pacific Northwest Laboratory, as the lead laboratory in the CAES Program, assists DOE, Division of Energy Storage Systems in program planning, budgeting, contracting, managing, and reporting. The overview summarizes the CAES program, outlines the specific tasks and identifies the performers, indicates progress on current tasks, points out anticipated activities, and examines significant milestones.

43133 (CONF-781046—, pp 337-347) **Fluid flow and thermal analysis for CAES in porous rock reservoirs.** Wiles, L.E.; Oster, C.A. (Battelle Pacific Northwest Labs., Richland, WA). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The analysis is a continuation of work initiated at PNL in FY-1377. A computer code was developed in FY-1977 to define the hydrodynamic and thermodynamic response to simulated mass cycling in a CAES dry porous media reservoir. The code was based on one-dimensional radial transport of mass and energy. The capability of the code has been extended in FY-1978 to include a one-dimensional, radial flow analysis of the effects of vapor and liquid phase water on reservoir performance. Parametric analysis included consideration of a range of injection temperatures, injection humidities, and residual water levels. Potential consequences of the presence of water related to deliverability, thermal energy recovery, working fluid recovery, and storage volume are evaluated. Also, two-dimensional modelling has been developed for dry reservoirs to include the effects of gravity, vertical heat losses and the effects of stratified permeability.

43134 (CONF-781046—, pp 349-354) **Thermo mechanical stress analysis of porous rock reservoirs.** Friley, J.R.; Doherty, T.J. (Battelle Pacific Northwest Labs., Richland, WA). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Stress levels in a generic porous rock compressed air energy storage site were investigated. Site loadings considered thermal, pore pressure, and in situ effects. Loading conditions simulated site operation for approximately one year of reservoir charging and discharging. Structural concerns focused primarily on tensile stress and fatigue stress magnitudes. In addition, the reservoir structural response due to tensile fracture of the cap rock region was investigated. For the conditions studied, fatigue stress levels were observed to be greatest in the porous material. These stresses decreased with age of reservoir operation and with distance from the well bore. Tensile stresses were observed to be greatest in the cap rock. While the tensile stress magnitude will most likely depend on site dependent overburden characteristics, mechanisms thought to cause this tensile behavior were postulated. While lack of site dependent information precluded interpretation of localized fatigue and fracture stress levels, it is felt that several salient features of cap rock and porous rock structural behavior in a porous rock reservoir were illustrated.

43135 (CONF-781046—, pp 355-362) **Potential air/water/rock interactions in a porous media CAES reservoir.** Stottlemyre, J.A.; Smith, R.P. (Battelle Pacific Northwest Labs., Richland, WA). 1978.
From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

There appears to be motivation for storing elevated temperature (50 to 300°C) compressed air in underground porous media reservoirs. The feasibility of this concept depends to a major extent, on the potential physical and chemical response of the reservoir to any new environmental conditions imposed by Compressed Air Energy Storage (CAES) operations. For example, changes in absolute and relative permeabilities due to elevated and time varying temperatures, interstitial fluid pressures, humidity conditions and free oxygen would be of specific interest. Ten potential reservoir damage mechanisms are discussed: (1) disaggregation and particulate plugging; (2) thermo-mechanical plugging; (3) corrosion; (4) clay swelling and dispersion; (5) matrix consolidation; (6) water evaporation and mineral precipitation; (7) oxidation reactions; (8) hydrolytic reactions; (9) mineral solutioning and precipitation; and (10) fluids incompatibility. These topics are discussed in what is considered their order of importance with respect to the CAES concept. Fatigue failure of well casings and cement materials is also considered an exceedingly important item, but is not elaborated on. Finally, some explanation of current and planned experimental and theoretical investigations is presented.

43136 (CONF-781046—, pp 364-373) **Preliminary design and stability criteria for CAES hard rock caverns.** Gnirk, P.F.; Port-Keller, D.S. (RE/SPEC Inc., Rapid City, SD). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The primary objectives of the study have been to compile rock properties data from the literature; to formulate a preliminary set of design and stability criteria for underground CAES hard rock caverns; and to identify areas of required research. The rock properties compilation has concentrated on assembling and evaluating those physical, chemical, petrophysical, thermal and mechanical characteristics and properties of igneous, metamorphic, and sedimentary rock types for which the CAES concept is applicable. This survey has indicated that the data base for hydrological and thermomechanical properties is generally inadequate for jointed rock under conditions of elevated temperature and increased moisture presence. In general, the formulation of preliminary design and stability criteria for CAES caverns has been based on information available for large underground caverns utilized for mining purposes.

43137 (CONF-781046—, pp 376-383) **Preliminary long-term stability criteria for compressed air energy storage caverns in salt domes.** Thoms, R.L. (Louisiana State Univ., Baton Rouge). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Caverns in salt domes offer perhaps the most attractive type of geostorage for compressed air energy. Storage of hydrocarbons in salt dome caverns has been practiced in the U.S. Gulf Coast region for approximately twenty-seven years, however this kind of storage has involved mainly liquids and relatively slowly varying pressure loadings. Compressd air energy storage (CAES) in salt caverns will involve continuous daily cycling of pressure, temperature, and humidity. Possible deleterious effects due to cyclic loadings must be controlled such that the CAES caverns remain stable and functional over time periods of approximately thirty-five years. Long-term stability criteria are discussed relative to CAES caverns in salt domes. The criteria are based on a review of the technical literature and interviews with persons knowledgeable about storage in salt domes. The methodology for development and implementation of quantitative criteria specific to any particular potential CAES dome also is presented.

43138 (CONF-781046—, pp 386-392) **Fabric analysis of rock subjected to cycling with heated, compressed air.** Pincus, H.J. (Univ. of Wisconsin, Milwaukee). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

An essential component of current investigations of compressed air energy storage in aquifer-type rocks is the characterization of changes with ventilation in pore-and-grain structure of the rocks, particularly as related to porosity and permeability. In addition to conventional microscopic examination, we are using Fourier optics to express changes in spatial frequency and orientation of grains, pores and microcracks. Optical Fourier amplitude transforms depict the distribution of spatial frequencies and orientations in their input-images. We can also express the similarity between pairs of input images by cross-correlating their transforms. Each of these Fourier optical procedures has detected some changes with ventilation in rock fabric. Differences between rocks are often greater than differences in the same rock associated with ventilation. Differences in gross physical characteristics among some rocks are consistent with contrasts in fabric.

43139 (CONF-781046—, pp 394-401) **Numerical modeling of behavior of caverns in salt for compressed air energy storage.** Cundey, T.E.; Serata, S. (Serata Geomechanics, Inc., Berkeley, CA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Finite element techniques are being used to establish general design criteria for caverns in salt formations that could be used for compressd air energy storage (CAES). The three types of parameters being studied are geological (in situ stresses, material properties), geometric (cavern dimensions, cavern spacings), and operational (air pressures, air temperatures). The numerical studies are being supplemented by a laboratory testing program developed to determine the effect of a cyclic loading environment on the material properties of rock salt. The five phases of the overall program are described, and the work completed to date is discussed. Preliminary ranges of the most significant parameters are presented. Areas in which additional research is necessary are identified, with particular regard to laboratory testing.

43140 (CONF-781046—, pp 440-447) **Advanced CAES system studies.** McKinnon, M.A. (Battelle Pacific Northwest Labs., Richland, WA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The primary objective of this program during FY-1978 was to evaluate and screen a number of advanced concepts available for integration with compressed air energy storage (CAES) systems. The principal results and conclusions reached from a preliminary assessment of four concepts for heating air without using premium fuels are summarized. The concepts considered were Nuclear Waste Heat Augmented CAES, Magnetohydrodynamics (MHD) combined with CAES, Coal Gasification used with CAES, and Fluidized Bed Combustion (FBC) used with CAES. In addition to the above studies a comparative economic analysis of CAES in a hard rock cavern was made for three systems, a conventional fired system, a hybrid system using a single stage of thermal energy storage (TES), and a no fuel double stage TES system. Conclusions reached from the studies are: (1) nuclear waste decay heat utilization in conjunction with a CAES system is technically feasible but the potential fuel savings will not compensate for environmental concerns or justify the additional system complexities, (2) MHD has potential for a good match with CAES but should not be studied further until the MHD problems have been solved, (3) Coal Gasification and FBC require more study, (4) Hybrid CAES systems and no fuel CAES systems using TES can be competitive with conventional CAES if there is a large enough differential between compression power costs and fuel costs.

43141 (CONF-781046—, pp 450-454) **Solar thermal augmentation of CAES.** Flynn, G.T. (Massachusetts Inst. of Tech., Lexington). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A storage system which combines an adiabatic compressed air storage plant with a solar thermal central receiver is described. A packed pebble bed is used to store the heat of compression generated during the charging of the compressed air reservoir. This heat is then returned to the air on discharge of the reservoir. This stored thermal energy minimizes the solar thermal energy required to raise the air temperature to 1500°F at the turbine inlet. The system described is based on a central receiver design proposed by Boeing. The turbomachinery is within the state-of-the-art, but would be built specifically for this application. Economic screening curves are given which compare conventional and adiabatic CAES for both coal fired and nuclear base load pumping. This hybrid system is marginally competitive with conventional CAES on the basis of levelized fuel costs of $3.55 per MBtu and nuclear off-peak pumping costs of 7.0 mills per kWh.

43142 **Compressed air storage as a way of covering peak load demands.** Szewc, B. (Politechnika Slaska, Gliwice, Poland). *Energetyka;* **32**: No. 6, 213-216(Jun 1978). (In Polish).

A method of covering peak load demands of large urban and industrial agglomerations from gas turbine power plants, using compressed air stored during off-peak periods is described. In order to keep the material balance unchanged the production of hydrogen is suggested in return for the delivered natural gas. Electrolyzer batteries would constitute a convenient stand-by power source for the power system. The use of worked out mines as compressed air storage reservoirs is suggested.

PUMPED HYDRO

43143 (CONF-781046—, pp 306-314) **Evaluation of one and two stage high head pump/turbine design for underground power stations.** Degnan, J. (Allis-Chalmers Corp., York, PA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The significant design considerations found during development of one and two stage reversible hydro machinery for the high head underground pumped hydro storage (UPHS) project currently funded through the U.S. Department of Energy (D.O.E.) are summarized. The immediate objectives of the initial phase of this D.O.E. investigation are: (1) extension of the present state-of-the-art technology for high head single and double stage pump/turbines to heads beyond 500 and 1000 meters respectively; (2) to generate preliminary machine designs which will comply with the required operating characteristics for UPHS and also serve as a basis for development of model testing procedures and equipment; (3) to project the manufacturing costs of any proposed hydro-turbine equipment resulting from the investigation; and (4) evaluate the feasibility of the one and two stage pump/turbine propositions for operation at a

rated power of 500 megawatts under heads of up to 1000 and 1500 meters respectively. Examples of the preliminary single and double stage machine configurations are included. Discussion of the special analyses and results leading to these machine designs is given and finally, conclusions as to the feasibility and limitations of each type of machine are drawn according to their expected cost, mechanical nd hydraulic performance.

43144 (CONF-781046—, pp 316-327) **Multistage turbine-pump with controlled flow rate.** Gokhman, A.; Ozboya, N. (Univ. of Miami, Coral Gables, FL). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Results of the preliminary part of the development of the new hydraulic machine Multistage Turbine-Pump with Controlled Flow Rate are presented. The hydraulic analysis of the turbine-pump shows that this new machine has the unique feature to regulate the flow rate even in the pump mode (the conventional turbine-pumps cannot control the flow rate in the pump mode). This unique feature makes the new turbine-pump especially attractive for the pumped-storage plant applications to store the energy produced by the plants utilizing noncontrollable natural energy sources such as solar energy, wind energy, etc. Obviously, during the process of storing energy, the conventional machine will cause the waste of energy produced due to its lack of ability to regulate the flow rate. The new turbine-pump with controlled flow rate is more complicated and consequently more expensive than the conventional one for the same parameters (head, power) as can be concluded from the conceptual design of the new machine. However, the turbine-pump with controlled flow rate does not require an operating valve, since the outer cylinder of the movable upper band of the distributor (in case of multistage machine, the distributor of the first stage) acts as cylindrical valve. Therefore it is not certain that new turbine-pump which does not need the operating valve will cost more than conventional turbine-pump with the operating valve (it is well known that the high head valve for power plants is very expensive). Even in the case that the new machine is more expensive than the conventional one with the operating valve, the additional cost of the new machine will be offset by the energy savings due to the unique feature of flow-rate regulation.

FLYWHEELS

43145 (AD-A—060351) **Development of a high energy storage flywheel module. Final report 30 Jun 75-30 May 78.** Hodson, D.R. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 30 May 1978. Contract DAAG53-75-C-0278. 160p. NTIS PC A08/MF A01.

A three-phase 35 month program was conducted to design and build a complete flywheel energy storage system rated at 30 kWh (40 HP-hrs) at 15,000 RPM. In the first phase, tradeoff studies were completed to select optimum materials, flywheel configuration, interface characteristics and to define performance characteristics. During the second phase, a detail design of the system was generated, including all drawings, specifications, and descriptive data. A subscale model of the fullscale flywheel was also fabricated and tested during phase 2. The third and final phase of the current program consisted of fabrication and assembly of the fullscale 30 KWH flywheel module and associated control equipment. All program hardware was stored at Rocketdyne pending decisions to proceed with test of the system identified as Rocketdyne model RS-31.

43146 (CONF-781046—) **Proceedings of the 1978 mechanical and magnetic energy storage contractors' review meeting.** Chang, G.C.; Barlow, T.M. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract W-7405-ENG-48. 450p. Dep. NTIS, PC A19/MF A01.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A separate abstract was prepared for each individual paper. (TFD)

43147 (CONF-781046—, pp 44-54) **Low cost flywheel demonstration.** Rabenhorst, D.W. (Johns Hopkins Univ., Laurel, MD). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The current Applied Physics Laboratory/Department of Energy Program involves the demonstration of a very low cost flywheel ($50/kWh) in a complete energy storage system. The program also includes the development and evaluation of low loss, long life bearing systems. The energy storage system, operating at 115 VAC, has a capability of storing one 1 kWh of energy and of accepting or delivering this energy at an average rate of 2 kW power level. A final output of the program is the extrapolation of the flywheel design to a full size unit with a storage capability of 10 to 100 kWh. In addition to meeting the program objectives, this program has resulted in notable achievements in related flywheel technology: a flywheel configuration has been demonstrated which allows the exploitation of a wide variety of applicable low cost materials in a very inexpensive fabrication process; a flywheel suspension system has been developed which reduces bearing loads by more than 90%, thus permitting the use of smaller bearings at lighter loads and longer projected life. Resulting bearing performance approaches that of a three plane magnetic suspension--without the disadvantages of the magnetic system; several novel bearing systems were evaluated which have exhibited further reduced losses while having an order of magnitude longer predicted life; and a number of novel low cost flywheel materials were evaluated which promise future flywheels having even lower cost.

43148 (CONF-781046—, pp 76-78) **Flywheel test facility.** Smith, B.B. (Union Carbide Nuclear Corp., Oak Ridge, TN). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A flywheel test facility was built at the Y-12 Oak Ridge Plant during Fiscal 1978. The facility is designed for 2 kWh energy level with minimum speeds to 60,000 RPM. The test machine is located below grade in a concrete pit. The objectives for constructing the facility are to provide a safe facility for performing dynamic testing while developing a composite flywheel and to provide test data for containment and mounting studies. The facility is located in an uncleared area to allow relatively easy access to industrial representatives and other government agencies.

43149 (CONF-781046—, pp 99-107) **Aerodynamic heating of high-speed flywheels in low-density environments.** Baer, M.R. (Sandia Labs., Albuquerque, NM). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The aerodynamic heating of high-speed flywheels in low-density environments is discussed. A computer code has been developed to predict temperature fields in flywheels of variable geometry and consisting of multiple composite materials with nonisotropic, temperature-varying thermal properties. Allowances have been incorporated for variable environmental conditions, time-varying spin rates, and the choice of slip-flow or free-molecular aeroheating. Major results from the code indicate that environmental pressures below 10^{-3} torr are necessary to avoid steady-state temperatures exceeding 50°F above ambient. Protruding surfaces have the major potential to cause thermal problems.

43150 (CONF-781046—, pp 112-121) **Application of fluid film bearings and a passive magnetic suspension to energy storage flywheels.** Eusepi, M.W.; Martin, L.; Ray, A. (Mechanical Technology Inc., Latham, NY). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The results of an investigation to establish realistic fluid film bearing parameters and a passive magnet suspension system for the support of energy storage flywheels in the range of 10 kWh to 100 kWh are presented. A specific design for a three lobe preloaded journal bearing and a shrouded step thrust bearing was established for a 10 kWh flywheel which weighs 1600 lb and has a maximum rotation speed of 12,500 rpm. Equations are presented to assist in establishing the bearing design requirements for other flywheel sizes. The magnetic suspension system designed to support 90% of the flywheel weight operates in an attractive mode and incorporates a novel configuration which provides a positive stiffness slope for the attractive magnet assembly.

43151 (CONF-781046—, pp 124-128) **Low-loss ball bearings for flywheel applications.** Eisenhaure, D.B.; Kingsbury, E.P. (Charles Stark Draper Lab., Inc., Cambridge, MA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Work performed for the analysis and test of ball bearings suitable for vehicular flywheel applications is summarized. Particular emphasis was placed on the full complement retainerless concept which prior research indicated had extremely low losses and long life at high speeds in a vacuum environment. The primary accomplishments during the first six months of this 12-month program were the procurement and modification of test bearings, the design and construction of a test fixture, and the development of a theoretical representation of the bearing losses. The primary accomplishments during the second half of the program were the development of a good data base for the test bearings and a ball bearing perform-

ance prediction model. This performance prediction model was formulated by combining the experimental data base with the theoretically derived model and allows the optimization of future ball bearing configurations for vehicular flywheel systems. Three sizes of standard bearings were modified to the full complement retainerless configuration. These modified bearings and one set of standard retainer bearings were tested during the contract. Friction losses were obtained for a variety of radial and axial loads and the results integrated into the performance prediction model.

43152 (CONF-781046—, pp 130-139) **Seal studies for advanced flywheel systems.** Anwar, I. (Franklin Research Center, Philadelphia, PA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A seal application for an advanced flywheel system where housing pressure (vacuum) is equal to 10^{-4} torr is being investigated. Many conventional types of seals can be ruled out due to such extreme pressure conditions. For a dynamic seal to work successfully, it should develop a compression ratio of 10^6 magnitude during its normal operation. In view of this, the principle of molecular vacuum pumps, where pressure ratios of this magnitude are obtainable, is being examined. It is believed that a flywheel seal system based upon molecular vacuum pump principles on the vacuum side and upon viscous flow principles on the high-pressure side can be developed. For future work, a design study is recommended where the concepts of molecular drag and turbo pumps are combined with one of the conventional configurations of the viscous pumping seal.

43153 (CONF-781046—, pp 143-148) **Composite flywheel for vehicle use.** Younger, F.C. (William M. Brobeck and Associates, Berkeley, CA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A program for the design and fabrication of a fiber-composite flywheel is described. The objective of the program is a usable energy in the range of 1 to 5 kWh with a total energy density in excess of 80 Wh/kg at the maximum operating speed. The design output power is 37 kW and the maximum dimensions are 0.6 m diameter and 0.2 m thickness. The design uses a biannulate rim of S2 fiberglass/epoxy overwrapped with Kevlar 49/epoxy. This rim is supported from an aluminum hub by polar catenary spokes filament wound with Kevlar 29/epoxy. The Kevlar 29/epoxy spokes have a lower tensile modulus than the rim materials so compatible strain levels can be achieved without excessive stress in the spokes. The stress analysis for the biannulate rim shows nearly optimum tangential stress levels in each of the two materials and a very reasonable distribution of radial stresses. Compressive radial stress occurs at the interface between the S2 fiberglass/epoxy and the Kevlar 49/epoxy. The spoke design concept permits a careful balance of spoke flexibility to assure that the spoke stiffness is adequate to maintain concentricity of the rim and hub to satisfy dynamic stability requirements while at the same time being flexible enough to allow dilation of the rim due to centrifugal loading without imposing excessive radial loads at the rim-to-spoke attachment points.

43154 (CONF-781046—, pp 156-161) **Progress in composite flywheel development.** Hill, P.W.; White, T.C.; Drewry, D.G.; Stewart, W.B. (Hercules Inc., Cumberland, MD). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Development of filament reinforced polymer (FRP) flywheels for energy storage in vehicles has been continuing at ABL with emphasis on material selection and design synthesis based on the filament winding process. Three species of designs have been studied: helically wound shells; circumferentially wound rims with radial spokes; and circumferentially wound contoured disks. The objective has been to evaluate the potential of design concepts with commercial merit. A new approach to the type 3 flywheel offers competitive performance in a wheel configuration that is more compact than other types and is also attractive from a mass production viewpoint. Combining optimum contour with programmed winding tension in a process that fixes the winding tension as the wheel is fabricated results in rated performance approaching 30-W-hr/lb and 1 W-hr/ cu in. for a rotor storing 1270 W-hr at the design operating speed. Design and fabrication are in progress under contract from DOE/Sandia. A description of the design concept, the basic theory of the design, and a summary of material properties is provided.

43155 (CONF-781046—, pp 164-170) **Advanced composite flywheel for vehicle application.** Davis, D.E. (Rocketdyne Div., Canoga Park, CA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Rockwell's high energy density composite wheel concept is based upon work done as part of a program in spacecraft power and attitude control. Experience and analytic capabilities which evolved during the early program will be utilized in the course of producing next-generation hardware. The design and present typical results of computer analyses treating operation and fabrication stresses are presented. The advantages of the concept (viz., great axial stiffness and high volume efficiency) are discussed. Earlier design problems are briefly touched upon.

43156 (CONF-781046—, pp 172-175) **High-energy-density flywheel.** Satchwell, D.L. (Garrett-AiResearch Manufacturing Co., of California, Torrance). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The design and fabrication of a flywheel rotor with an energy density of 80 W-hr/kg are described. The design features a multiring, S-glass and Kevlar composite material rim that is mounted on a graphite composite spoked hub. Composite material flywheels have been constructed with identical rim design and with aluminum spoked hubs. These flywheels have been successfully tested to energy densities of 53 W-hr/kg. The use of graphite composite material in place of the aluminum material significantly reduces the weight of the rotor assembly and thereby increases the energy density. The progress to date on this program and the program planned to complete the fabrication of a test specimen are presented.

43157 (CONF-781046—, pp 186-194) **Band type variable inertia flywheel and fixed ratio power recirculation applied to it.** Ullman, D.G. (Union Coll., Schenectady, NY). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A flywheel with variable moment of inertia created by thin bands winding about a central hub in a hollow casing is introduced. This mechanism combines the functions of energy storage and power control. Configurations with the moment of inertia change internally controlled through fixed gearing are introduced.

43158 (CONF-781046—, pp 196-203) **Cellulosic flywheels.** Erdman, A.G.; Hagen, D.L.; Frohrib, D.A.; Garrard, W.L. (Univ. of Minnesota, Minneapolis). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Natural cellulosic materials have been shown to have moderately high tensile strengths, low densities and thus reasonably high specific energies. Thus they appear to be technically feasible and economically competitive for stationary flywheel energy storage applications where volume and total mass are not in question. An overview of previous and current research on cellulose flywheels is given. It has been found that one or two ton birch plywood rotors could be readily assembled and eight ton kraft paper rotors are available. Even larger rotors can be made using existing technology. The birch plywood rotors can be made at a cost of 4 wh/$ and the kraft paper rotors are available at 11 wh/$, with further improvements in costs predicted. Intrinsic specific energy of 294 kJ/kG (37 wh/lb) has been demonstrated for kraft paper. The objectives of current research are to establish the working strengths of cellulose in a vacuum as a function of moisture content and the cyclic fatigue expected in the rotor; to develop methods to attach hubs and balance cellulose rotors; and to study the fatigue of representative rotors and hubs under actual cyclic operating conditions. Other objectives include the vibrational problems during operation, and the design and implementation of controls for the flywheel system. The efficiencies and use of continuously variable traction drives are also being studied.

43159 (CONF-781046—, pp 206-209) **Concept for suppression of nonsynchronous whirl in flexible flywheels.** Vance, J.M. (Texas A & M Univ., College Station). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

An energy-storage flywheel sized for home or farm use is being developed at Texas A & M University. A unique feature of this flexible flywheel is its construction from flexible fibers (such as synthetic rope) with no bonding agent. The potential advantages are low cost, self balancing, and increased safety in operation. The one current disadvantage, a whirling instability, is the major subject of the present contract. A design concept to suppress the instability is now being analyzed and is described.

43160 (CONF-781046—, pp 212-225) **Conceptual design of a flywheel energy storage system.** Younger, F.C. (William M. Brobeck and Associates, Berkeley, CA). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A conceptual design of a flywheel energy storage system suitable for on-site interfacing with small scale solar energy sources is being developed. The basic design objective is to provide a generous margin of safety and above average reliability and efficiency at the lowest practical cost. The basic design concept and the general approach to the conceptual design of the energy storage system are discussed. The basic concept to interface with solar energy sources utilizes a constant voltage motor/generator directly coupled to a flywheel rotor. The voltage level of the motor is maintained at the optimum operating voltage of the array of photovoltaic cells. Power is drawn from the flywheel-driven generator when the voltage output of the array drops below its optimum value and power is delivered to the flywheel via the generator (then operating as a motor) when the voltage rises above the optimum value. A variety of motor types and flywheel rotor types has been studied to arrive at a conceptual design to meet the program objectives. A fiber-composite rotor driving a separately-excited dc motor appears to satisfy the basic requirements. To obtain acceptable efficiency and low rundown losses, the flywheel operates in a vacuum and has a combination of magnetic thrust support and ball bearings to reduce bearing friction in an economical fashion.

43161 (CONF-781046—, pp 228-233) **Residential flywheel with turbine supply.** Place, T.W. (AiResearch Manufacturing Co. of California, Torrance). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

A flywheel system that stores energy from a wind turbine source and converts the energy to 60-Hz, 220-V output for residential use is examined. The typical residence has a 1500-sq ft floor area with a maximum power level of 5 kW. The purpose of the study is to determine the cost/benefits of storing wind energy in a flywheel and using it on a demand basis. The study examines the systems and the flywheel rotor materials that offer the greatest promise for reducing the initial cost. The progress to date on the program is presented and the work planned to complete the study is described.

43162 (CONF-781046—, pp 457-461) **Application of flywheel energy storage technology to solar photovoltaic power systems.** Millner, A. (Massachusetts Inst. of Tech., Lexington). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Solar photovoltaic (PV) electric power systems presently being developed invariably use electric storage batteries when on-site energy storage is required. Moreover, studies of future PV power systems assume continued use of batteries for on-site storage, albeit with more advanced, efficient and less expensive battery designs. This preeminence is due at least in part to the generally held conviction that no other on-site storage system can compete economically with batteries for PV usage. However, studies performed during the past year at MIT/Lincoln Laboratory show that flywheel energy storage will be technically and economically competitive with either present-day or advanced storage batteries if the flywheel storage system is properly configured. This conclusion was reached after comparing battery and flywheel storage in a systems context, whereby their influence on other subsystems (such as inverters) was determined.

43163 **Rotatable mass for a flywheel.** Weyler, G.M. Jr. US Patent 4,098,142. 4 Jul 1978. Filed date 14 Nov 1975. 4p.

An improved rotable mass for a flywheel, characterized by a plurality of coaxially aligned, contiguous disks mounted on a spin shaft is presented. Each disk of the plurality is formed by a plurality of woven fibers disposed in a plane transversely related to an axis of rotation with the fibers of alternate disks being continuous throughout their length. The mid-portion of the fibers of the remaining disks of the plurality is removed for defining annular voids concentrically related to the spin shaft.

THERMAL

REFER ALSO TO CITATION(S) 42708, 42745, 42770, 42772, 42773

43164 (N—79-11473) **Applications of thermal energy storage to process heat and waste heat recovery in the iron and steel industry. Final report, Sep 1977—Sep 1978.** Katter, L.B.; Peterson, D.J. (Rocket Research Corp., Redmond, WA (USA)). Oct 1978. Contracts EC-77-C-01-5081;EC-77-A-31-1034. 136p. NTIS PC A07/MF A01.

The system identified operates from the primary arc furnace evacuation system as a heat source. Energy from the fume stream is stored as sensible energy in a solid medium (packed bed). A steam-driven turbine is arranged to generate power for peak shaving. A parametric design approach is presented since the overall system design, at optimum payback is strongly dependent upon the nature of the electric pricing structure. The scope of the project was limited to consideration of available technology so that industry-wide application could be achieved by 1985. A search of the literature, coupled with interviews with representatives of major steel producers, served as the means whereby the techniques and technologies indicated for the specific site are extrapolated to the industry as a whole and to the 1985 time frame. The conclusion of the study is that by 1985, a national yearly savings of 1.9 million barrels of oil could be realized through recovery of waste heat from primary arc furnace fume gases on an industry-wide basis. Economic studies indicate that the proposed system has a plant payback time of approximately 5 years.

43165 (NSRDS-NBS—61(Pt.2)) **Physical properties data compilations relevant to energy storage. II. Molten salts: data on single and multi-component salt systems.** Janz, G.J.; Allen, C.B.; Bansal, N.P.; Murphy, R.M.; Tomkins, R.P.T. (Rensselaer Polytechnic Inst., Troy, NY (USA). Cogswell Lab.). Apr 1979. Contract W-7405-ENG-48. 442p. Dep. NTIS, PC A19/MF A01.

The work provides selected data with value judgements for a set of 49 salt systems of interest as candidate materials for thermal energy storage sub-systems and for electrochemical energy storage systems. The physical properties assessed are: melting points; phase diagrams; eutectic compositions; density; surface tension; viscosity; electrical conductivity; diffusion constants for ions; heat of fusion; heat capacity; volume change on fusion; vapor pressure; thermal conductivity (liquid and solid); and cryoscopic constant. The status of corrosion studies in the form of annotated bibliographic summaries, and salient observations on safety and hazards are also reported. A summarizing series of tables are provided as index to the data-gaps status for this set of candidate materials.

43166 (SAND—78-2282C) **Numerical simulation of dual-media thermal energy storage systems.** Gross, R.J.; Hickox, C.E.; Hackett, C.E. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 38p. (CONF-790808—3). Dep. NTIS, PC A03/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

An easily implemented, finite-difference predictor-corrector numerical technique originated by MacCormack is used to solve for fluid and solid temperature distributions in one-dimensional flow through a finite packed bed. The method allows for temperature dependent properties, time-varying inlet conditions and nonuniform initial conditions. The numerical method agrees with the classical Schumann model to within 1% in simulations which exhibit fully-developed thermal gradients of 310°C/m. Additional examples demonstrate the flexibility of the technique and that the constant property assumption may lead to temperature distributions significantly different from a more realistic variable property assumption. The attractiveness and uniqueness of the method is, then, its accuracy, flexibility, ease of implementation and efficiency computation-wise.

43167 **Off-peak coolness storage.** MacCracken, C.D. (Calmac Manufacturing Corp., Englewood, NJ). pp 371-373 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

BATTERIES

REFER ALSO TO CITATION(S) 43365

DESIGN AND DEVELOPMENT

43168 (EPRI-EM—1051(Pt.1-3)) **Development of the zinc—chlorine battery for utility applications. Interim report, January 1, 1977—March 31, 1978.** Birk, J. (Energy Development Associates, Madison Heights, MI (USA)). Apr 1979. 284p. Dep. NTIS, PC A13/MF A01.

The zinc—chlorine battery system is presently under development as a peak-shaving energy-storage device for the electric-utility industry. The principal thrusts of the present program were: preparation and analysis of a new 100-MWh plant design; and design, fabrication, and initial testing of a 45-kWh battery module - the basic unit of the new 100-MWh plant design. Development programs on electrode research, electrolyte optimization, cell design, battery-performance verification, and low-cost materials and processes were conducted. A conceptual design of a 100-MWh battery plant is based on the concept of fully integrated zinc—chlorine hydrate battery

modules. The battery plant comprises thirty-six independent strings - each string consisting of 44 series-connected 66-kWh battery modules. A conceptual manufacturing plan for a production rate of 100 battery modules per day was prepared. The installed cost of the 100-MWh battery plant was estimated to be $26/kWh plus $91/kW (1977 $). The safety, environmental, and legal aspects of siting 100-mWh zinc—chlorine battery plants at substations in residential areas were also analyzed. The design is judged to be optimal in the areas of performance, safety, and manufacturability, while comparing favorably in cost and reliability to earlier designs. The module prototype was designed, fabricated, assembled, and tested. The 45-kWh module, which performed well as a system, delivered in excess of the design level for dc energy output. However, the efficiency, at 50%, was lower than the design target. The significant accomplishments in the development program are set forth. 92 figures, 56 tables.

43169 (EPRI-EM—1051(Pt.4)(App.)) **Development of the zinc—chlorine battery for utility applications. Interim report, January 1, 1977—March 31, 1978.** Birk, J. (Energy Development Associates, Madison Heights, MI (USA)). Apr 1979. 310p. Dep. NTIS, PC A14/MF A01.

The zinc—chlorine battery system is presently under development as a peak-shaving energy-storage device for the electric utility industry. The principal thrusts of the present program were preparation and analysis of a new 100-MWh plant design; and design, fabrication, and initial testing of a 45-kWh battery module - the basic unit of the new 100-MWh plant design. Development programs on electrode research, electrolyte optimization, cell design, battery-performance verification, and low-cost materials and processes were conducted in support of these objectives. A new conceptual design of 100-MWh battery plant is based on the concept of fully integrated zinc—chlorine hydrate battery modules. The battery plant comprises thirty-six independent strings, each string consisting of 44 series-connected 66-kWh battery modules. A conceptual manufacturing plan for a production rate of 100 battery modules per day was prepared. The installed cost of the 100-MWh battery plant was estimated to be $26/kWh plus $91/kW (1977 $). The safety, environmental, and legal aspects of siting 100-MWh zinc—chlorine battery plants at substations in residential areas were also analyzed. The design is judged to be optimal in the areas of performance, safety, and manufacturability, while comparing favorably in cost and reliability to earlier designs. The module prototype was designed, fabricated, assembled, and tested. The 45-kWh module, which performed well as a system, delivered in excess of the design level for dc energy output. However, the efficiency, at 50%, was lower than the design target. The significant accomplishments in the development program are set forth. 144 figures, 54 tables.

PERFORMANCE AND TESTING

43170 (SAND—79-0090) **Studies of the abnormally high peak voltage observed with FeS_2 depolarized thermal batteries.** Levy, S.C.; Crafts, C.C. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

Studies indicated that the initial voltage spike occurring in FeS_2 depolarized thermal batteries at low current densities is due to a surface impurity on the FeS_2 particles. This impurity is the result of a reaction with atmospheric oxygen. Several techniques were developed for lowering the initial peak voltage spike and thereby attaining longer active lives to 75 or 80% of peak voltage cutoff. The most successful technique is to put a thin electrolyte—binder layer on the side of the cathode pellet contacting the collector. 9 figures, 4 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 43165, 43170

43171 (EPRI-EM—1005) **Battery Energy Storage Test (BEST) Facility first progress report.** Hyman, E.A. (Public Service Electric and Gas Co., Newark, NJ (USA)). Feb 1979. Contract EY-76-C-02-2857. 94p. Dep. NTIS, PC A05/MF A01.

The Battery Energy Storage Test (BEST) Facility will be a national center for testing and evaluating battery energy storage systems, including associated electrical conversion equipment developed for use on electric power grids. The project is funded jointly by EPRI, DOE, and PSE & G. The BEST Facility program consists of four phases: design, construction, testing and acceptance, and operation. This report covers the activities of the first three phases during the time period March 1, 1976 to July 1, 1978. Included are a background review, key milestone dates, a description of activities for the three phases (including those associated with the future implementation of the second test bay), and a description of major interactions between the BEST Facility program and the advanced battery development programs. 15 figures, 3 tables.

APPLICATIONS

REFER ALSO TO CITATION(S) 43168, 43169, 43286

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 44193

43172 (N—79-11466) **Energy. A continuing bibliography with indexes, Issue 18.** (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1978. 448p. NTIS PC E07.

This issue of Energy lists 1038 reports, journal articles, and other documents announced between April 1, 1978 and June 30, 1978 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

43173 **New energy technology: closer than we think.** Coad, W.J. (Washington Univ., St. Louis, MO). *Heat., Piping Air Cond.;* **51**: No. 5, 91, 100(May 1979).

Contrary to United States activities, the odds are slim that even with ample funds a new technology can be developed quickly enough to prevent an energy shortfall. Except for nuclear conversion, there have been few, if any, breakthroughs in energy conversion since the 19th century. It is suggested that some rediscovered new technologies (i.e., solar energy utilization, heat pump, integrated energy cycles) should be studied to determine why they were discarded previously. The new energy technology breakthroughs, are going to be from known technologies. They will come from the less romantic areas of complex engineering technology, conservation, system parasitic analyses, heat transfer, hydraulics, and in fundamental thermodynamics.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 43185, 43234, 43235, 43272

43174 (BNL—26045) **Dynamics and control: energy conversion, delivery, and demand analysis.** Hoffman, K.C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 22p. (CONF-790636—1). Dep. NTIS, PC A02/MF A01.

From Workshop on process and systems dynamics and control, ASME; Denver, CO, USA (20 Jun 1979).

Techniques of mathematical modeling and modern control theory, using microprocessors and advanced measurement and control devices, are extensively applied to components and systems for the conversion and delivery of energy. The projection of energy demands, as a function of economic growth and energy price, is also the subject of active research and analysis. This position paper reviews the current state-of-the-art of analysis in these areas dealing with the planning and operation of energy systems that deliver fuels and electric power. Future research directions are also discussed. 25 references.

43175 (CONF-790459—4) **Modeling approach suitable for energy system.** Goetschel, D.V. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

Recently increased attention has been placed on optimization problems related to the determination and analysis of operating strategies for energy systems. Presented in this paper is a nonlinear model that can be used in the formulation of certain energy-conversion systems-modeling problems. The model lends itself nicely to solution approaches based on nonlinear-programming algorithms and, in particular, to those methods falling into the class of variable metric algorithms for nonlinearly constrained optimization.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 42546, 43197, 43202, 43205, 43211, 43220, 43235, 43264, 43277, 43287, 43292, 43792

43176 (BNL—50890) **Programmatic areas for U.S. assistance for energy in the developing countries.** Palmedo, P.F.; Nathans, R.; Beardsworth, E.; Tschannerl, G. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1978. Contract EY-76-C-02-0016. 118p. Dep. NTIS, PC A06/MF A01.

A previous report entitled Energy Needs, Uses and Resources in Developing Countries presented an analysis of the energy problems facing the developing countries and the types of solutions that are available to them. In this report a wide variety of U.S. assistance programs which can facilitate those solutions is identified. The report identifies 28 programmatic areas for assistance activities. In each area specific projects are indicated as examples and the general level of required funding is estimated. Twenty-two programmatic areas cover the development of conventional and renewable energy resources and technologies; six with assessment and planning, energy institutions, and training and education. Two hypothetical overall assistance programs are described with possible project distributions encompassing some twenty countries. A broadly based U.S. energy assistance program which draws upon the highest quality of U.S. technical capabilities can make a significant contribution to the future economic and sociologic well-being of the developing countries of the world.

43177 (DOE/EIA—0184/2) **Feasibility of financing domestic energy development during 1978—1984. Analysis report.** Kanhouwa, S.P. (Department of Energy, Dallas, TX (USA). Energy Information Administration). May 1979. 161p. Dep. NTIS, PC A08/MF A01.

This report is an elaboration and an extension of the Section on Finance presented in Chapter 3 of the 1977 Annual Report to the Congress (ARC) by the Energy Information Administration. It introduces the satisfactory financing of energy as yet another factor likely to significantly affect the sensitivity of alternative energy-supply projections shown in the ARC. Accordingly, its primary purpose is to assess whether the growth of private investment demand in energy - as implied by the projections - can be adequately met in the future. For the above purpose, aggregate estimates of energy capital requirements are derived for the seven-year period from 1978 to 1984. This is done by taking into account capacity additions and levels of exploration and development activity necessary to attain alternative levels of domestic energy output. The latter are abstracted from Projection Series A (high-supply, high-demand), Projection Series C (mid-supply, mid-demand), and Projection Series E (low-supply, low-demand). These correspond to high-, medium-, and low-capital requirements, respectively. The cumulative amounts estimated for each Series are tabulated.

43178 (LBL—8744) **Spatial data on energy, environmental, socioeconomic, health and demographic themes at Lawrence Berkeley Laboratory: 1978 inventory.** Burkhart, B.R.; Merrill, D.W. (eds.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 82p. Dep. NTIS, PC A05/MF A01.

Spatial data files covering energy, environmental, socio-economic, health, and demographic themes are described. Descriptions provide data dates, abstracts, geographic coverage, documentation, original data source, availability limitations, and contact person. A current version of this document is maintained as part of the Socio-Economic-Environmental-Demographic Information System (SEEDIS) within the Computer Science and Applied Mathematics Department, and is available for on-line retrieval using the Virginia Sventek, (415) 486-5216 or (FTS) 451-5216 for further information.

43179 (NMEI—76-158) **Study of lifeline as a form of low-income consumer relief in the context of utility rate-making.** DuMars, C.T.; Browde, M.B.; Taylor, S.; Shapiro, B.; Geer, M.; Brown, F.L. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Feb 1977. 157p. Univ. of New Mexico, Albuquerque.

This study evaluates the lifeline concept in terms of its cost-effectiveness as a means of relieving low-income consumers from the spiraling costs of energy. Part I provides a brief glossary of terms helpful to the reader unfamiliar with the language of utility rate-making. Part II seeks to define the lifeline concept, explain its underlying principles, and review the major arguments concerning its efficacy. Part III explains the methodology used to gather the sample data on low-income consumers of natural gas; data assembled are subjected to analysis, comparing low-income usage of natural gas with average residential usage, and computing the cost efficiency of lifeline as a program for the relief of low-income consumers at three different natural gas price levels. Part IV analyzes lifeline in a broader context - including concerns about relief to relatively low users, conservation of energy supplies, maintenance of company revenue, and ease and cost of regulation - using the California experience as a backdrop.

43180 (NP—23776) **Northern Cheyenne Tribe and energy development in southeastern Montana. Volume I. Social, cultural, and economic investigations.** Nordstrom, J.; Boggs, J.P.; Owens, N.J.; Sooktis, J. (Northern Cheyenne Research Project, Lame Deer, MT (USA)). Oct 1977. 268p. Old West Regional Commission, Billings, MT.

This report presents the results of a study of the social, cultural, and economic aspects of life on the Northern Cheyenne Reservation. Aspects of the development of their large coal resources are emphasized. A history of the Northern Cheyenne country is given in the introduction. Chapter I examines why a local rural area like southeast Montana (of which the reservation is a part) has a hard time controlling the economic development that takes place there. Chapter II examines the special place the reservation has within the regional economy. Chapter III looks at some of the many aspects of Cheyenne culture that have survived despite repeated efforts by white authorities to suppress or assimilate the culture out of existence. Chapter IV presents the attitudes of the Cheyenne people about alternative kinds of economic development that could take place on the reservation. Chapter V outlines the theoretical approach used in considering the issues in this report. Two theories are examined--acculturation and differentiation theories. The next chapter reviews the kinds of concerns any development option must take into account if it is to be consistent with Cheyenne culture and aspirations. Community development must go hand in hand and should not be seen as something to patch up or rebuild a community disrupted by extractive economic "development." The second part of thechapter focuses on the critical importance of tribal participation in any studies done on which economic development decisions are to be based. The final chapter reviews the data collected during the 1975 study. (MCW)

43181 (UT/CES-GS—2) **Community-level impacts projection system (CLIPS). Final report.** Monts, J.K.; Bareiss, E.R. (Texas Univ., Austin (USA). Center for Energy Studies). Feb 1979. 169p. Dep. NTIS, PC A08/MF A01.

This report describes efforts to develop a methodology suitable for assessing the local socio-economic impacts accompanying energy development in the state of Texas. CLIPS is intended to serve as a tool to assist local and state planners in anticipating and preparing for community-level socio-economic impacts. Following a discussion on the nature, use, and history of CLIPS in an introductory chapter, the general structure of CLIPS is discussed in Chapter 2. Following chapters on the Regional Baseline, The Community Baseline Population, The Regional Impact Population, and The Community Impact Population Projection Submodels, The Community-Level Socio-economic Assessment Submodel chapter is presented. The final chapter, Technical Documentation, includes technical information and a discussion on the components of the model. (MCW)

43182 **Economic growth, employment and energy.** Starr, C. (Electric Power Research Inst., Palo Alto, CA); Field, S. *Energy Policy;* 7: No. 1, 2-22(Mar 1979).

The importance of energy in achieving economic growth emerged as an issue in the USA at the end of the 1960s, when readily usable domestic supplies of inexpensive oil and natural gas began to dwindle. Because of this, energy considerations may, for the first time, begin to constrain society's freedom to explore future options for continued economic and social progress. Prudent planning requires that the US energy supply goal should be high enough to avoid energy constraints. This article estimates how much energy will be needed in the year 2000 for the USA to achieve social progress, unconstrained by energy availability. These estimates are based on examination of the interactions between economic growth, employment, and energy use. The USA may choose not to follow the historical trend of economic growth. If so, the authors feel that this should be a decision, reached on the basis of broad national economic policy, and should not be an unintended and unrecognized side-effect of energy policy.

43183 **Economic impacts of soil erosion control.** Seitz, W.D. (Univ. of Illinois, Urbana); Taylor, C.R.; Spitze, R.G.F.; Osteen, C.; Nelson, M.C. Contract 68-01-3581. *Land Econ.;* **55**: No. 1, 28-42(Feb 1979).

The results of several analyses aimed at assessing the economic impacts of soil erosion control policies are summarized. The analyses were carried out with several linear-programming models at the corn-belt, regional, and watershed levels of aggregation. In addition, the administrative cost for the public institutions required to implement the policies were approximated using the cost-synthesis approach. In general, the analysis indicates that improvements in soil erosion control can be achieved without severe impacts on the agricultural sector. Given the unestimated environmental benefits and the apparent possibility of developing a reasonable soil erosion control policy which would have moderate short-run costs and the potential for significant long-term benefit, more effective soil erosion control policy would likely be in the social interest, at least in the corn belt. 17 references.

43184 Twelfth general report on the activities of the European Communities in 1978. Luxembourg; Commission of the European Communities (1979). 377p. (NP—23748). European Communities Information Service, 2100 M. St. NW, Washington, DC.

The 1978 activities of the European Communities are summarized. In Chapter I, following and introductory section, two other sections are devoted to institutions and other bodies and financing Community activities. In Chapter II, Building the Community, the following are discussed: economic and monetary policy, internal market and industrial structures; customs union, competition, financial institutions and taxation, employment and social policy, regional policy, environment and consumers, agriculture, fisheries, transport policy, energy, safeguards, scientific and technological research and education, information management. In treating the enlargement of the Community in Chapter III, current negotiations and new applications dealing with Greece, Portugal, and Spain are highlighted; external relations are also discussed. In Chapter IV, general matters, community law, interpretation and application of the substantive rules of the Community law, and development of Community law are presented. (MCW)

43185 Three modes of energy cost analysis: then-current, base-year, and perpetual-constant dollar. Harnett, R.M. (Clemson Univ., SC); Phung, D.L. EY-76C-05-0033. *Energy Syst. Policy;* 3: No. 1, 61-72(1979).

This paper presents three modes of energy cost analysis and explores their interrelationships through algebraic discussions and numerical examples taken from ten synthetic fuel energy technologies. The depreciable capital component of total cost is analyzed for the technologies using preliminary estimates of their costs and perfomances. The numerical examples show that the three modes of analysis, when used with properly adjusted discount rates, produce the same ranking of the technologies.

43186 Social, economic, and cultural study of the Crow Reservation: implications for energy development. Billings, MT; Crow Impact Study Office (1977). 22p. (NP—23746). Old West Regional Commission, Hedden-Empire Building, Suite 228, Billings, MT.

Pressure has mounted for the Crow Tribe to develop its vast coal resources. Therefore, a study was initiated in 1975 to study the economic, population, social, and cultural conditions on the Crow reservation. During 1976—1977, a survey of the Crow Tribe was conducted with 1016 families. Questions in the survey included household composition, population characteristics, employment and education characteristics, people's attitude toward their culture, residential patterns, and people's feelings about resource development and its impacts, especially coal mining and conversion. Results are summarized to show that Crow people are concerned that their decisions on resource development will benefit and strengthen the tribe economically and socially and that damage to the Crow way of life be minimal. The Tribe still has to decide upon the final course of action. (MCW)

43187 Social, economic, and cultural study of the Crow Reservation: implications for energy development. Billings, MT; Crow Impact Study Office (1977). 283p. (NP—23744). Old West Regional Commission, Suite 228, Billings, MT.

Because there are about 4 1/2 to 6 billion tons of stippable coal in the eastern portion of the Crow Reservation, there has been great pressure on the tribe to decide if they should develop the resources. Baseline studies of current economic, demographic, social, and cultural conditions were made. A survey of the Crow Tribe was conducted with 1016 familes on or near the reservation during 1976 and 1977. Chapter II describes the study method and procedures. Chapter III describes the demographic, economic, social, and cultural conditions of the tribe as they now exist. Included in Chapter III is information about household composition, demographic characteristics of the members, the Crow Reservation economy, housing conditions, residential patterns and preferences, reservation medical and education services, and the Crow culture. Chapter IV describes the expectations of the tribe about the environmental, economic, social and cultural effects of resource development, specifically coal mining and conversion. Chapter V describes the results of an employment survey of all tribal programs which was conducted concurrently with the survey of family heads. Chapter V provides information on employment by occupation and ethnic group, wage profiles, seasonal peaks and lows in employment, and a description of fluctuations in funding levels of the various tribal programs. Chapter VI summarizes the principal findings of the research work conducted under the Old West Regional Commission grant.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 42231, 43183, 43249, 43723, 43772, 43780, 43792, 43793, 43828, 43829

43188 (DOE/EDP—0037) **Environmental Development Plan transportation programs.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Apr 1979. 159p. Dep. NTIS, PC A08/MF A01.

This is the first annual update of the Environmental Development Plan (EDP) for the DOE Division of Transportation Energy Conservation program. It identifies the ecosystem, resource, physical environment, health, safety, and socioeconomic concerns associated with the division's transportation programs. These programs include the research, development, demonstration and assessment (RDD and A) of seventeen transportation technologies and several strategy and policy development and implementation projects. The technologies under development are listed by subprogram along with the strategies and policies. This EDP presents a research and assessment plan for resolving any potentially adverse environmental concerns stemming from these programs. The methods for reducing per capita energy consumption in passenger and freight transportation can be broken into five categories: network improvements, operational changes, demand reductions, modal shifts, and improved vehicular energy conversion. The program addresses each of these areas, with emphasis on improving vehicular efficiency. (JGB)

43189 (DOE/ERD—0022) **Environmental readiness of emerging energy technologies. Summary report.** (Department of Energy, Washington, DC (USA). Div. of Technology Assessments). Jan 1979. 77p. Dep. NTIS, PC A05/MF A01.

The principal conclusions of the 21 Environmental Readiness Documents, which assessed 24 technologies are presented. Seven technologies were judged to have minimal environmental constraints. Four are solar technologies. The minimally constrained technologies nevertheless have some potential environmental, health, and safety problems, which will require careful management. Eleven technologies, many of which are high-technology systems with great promise for meeting the Nation's energy needs, were judged to have moderate environmental constraints. The moderately constrained technologies are, with few exceptions, in the predemonstration stage, with demonstration and environmental readiness likely to be achieved by 1980—1990. Six technologies, enhanced oil recovery (micellar polymer), hydrothermal, coal gasification, coal liquefaction, diesel cogeneration, and in situ oil shale, were judged to have significant environmental constraints that will require extensive environmental research and development before they can be widely used or before they can be deployed in some environmentally sensitive areas. The areas of common concern where productive research will relieve environmental constraints on many energy options are as follows: airborne emissions, respirable fine particulates, water pollution, solid waste disposal problems, toxic materials, and disruption of geologic formations or strata. Existing, proposed, or possible Federal and State standards can affect the siting or compliance costs of nearly all these technologies. The possible increase in energy or product costs because of stringent control measures required by existing standards is estimated at 10% or higher in the case of 12 of the 24 technologies. In the highest cost scenario (very stringent future standards), energy or product costs could rise by 25 to 50% for many of these technologies.

43190 (DOE/EV—0035) **Comprehensive environment, health, and safety program report, FY 1978.** (Department of Energy, Washington, DC (USA). Office of Program Coordinator). Feb 1979. 67p. Dep. NTIS, PC A04/MF A01.

A description is given of the environment, health, and safety research, development, and demonstration activities carried out and in progress. Discussion is presented under the following section headings: a comprehensive environment, health, and safety program: concept and implementation approach; the DOE Office of Environment - program and selected activities; environmental, health, and safety activities of other DOE offices; and, environmental, health, and safety activities of other federal agencies; titles of the four appendixes are: definition of research categories; summary of energy-related environment, health, and safety concerns; environment, health, and safety laws and regulations governing activities of the Department of Energy; and environmental, health, and safety activities of federal agencies participating in the Federal Inventory. (JGB)

43191 (EPRI-EA—1018) **Proposed research planning format for the Environmental Assessment Department. Final report.** Cohan, D.; North, D.W. (Decision Focus, Inc., Palo Alto, CA (USA)). Mar 1979. 127p. Dep. NTIS, PC A07/MF A01.

A proposal is made for a research planning format intended to help the Environmental Assessment Department (EAD) and its advisory structure plan, manage, and coordinate an effective research program responsive to the needs and concerns of its clients. These clients include EPRI planning staff, advisory groups, and management; the electric utility industry; and public and governmental groups concerned with energy and environmental policy. Issues of concern to EAD clients are reviewed, and alternative roles for EAD research are defined. The proposed planning format describes

explicity the steps in the planning and research process: identifying broad needs of industry and society; defining specific forcing issues; detailing research needs and objectives; developing research programs and projects; and producing the research results and integrated products that form the EPRI response to the original needs. Included in the report is an illustrative application of the planning format to the current EAD research program.

43192 (HCP/EV/6119—1) **Environmental data for energy technology policy analysis. Volume 1. Summary.** (Mitre Corp., McLean, VA (USA)). Jan 1979. Contract EE-77-C-01-6119. 106p. Dep. NTIS, PC A06/MF A01.

This document is designed to provide qualitative and quantitative information on the environmental aspects of different energy technologies. It is designed to serve as a reference document for planning within the Department of Energy. To ensure that the information presented remains current, updates will be provided as new, reliable data sources become available. The initial information source for this edition of the data book was the Strategic Environmental Assessment System (SEAS) data base. Other newer sources of information have also been consulted and have provided the basis for substantive changes in the data. Data are given on nuclear energy, coal, synthetic fuels, oil shale, solar energy, geothermal energy, and hydroelectricity. Each category of technology has been broken down into individual technology phases or base units for which environmental effects could reasonably be specified. For example, within the coal section, the base units start with coal mining and include cleaning and transportation as well as different types of power plants. Each base unit is described in terms of a typical unit or plant size and configuration. This information is provided on the individual base unit data sheet. In general, plant characteristics have been selected to represent present day or near term operation. An exception has been made for some of the newer technologies, such as solar. The data sheets present these technologies as they are envisioned for future eventual commercial applications. In addition to the description material, two basic categories of environmental concerns, resources used and residuals produced are addressed for each technology.

43193 (PB—287634) **Environmental impact assessment and review in energy decision making: State participation in the Lake Powell Region. Lake Powell research project bulletin.** Cortner, H.J. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Apr 1977. 75p.

This report examines the organizational structures and procedures the States of Arizona, Colorado, New Mexico, and Utah have implemented to take advantage of the National Environmental Policy Act (NEPA) requirement for the environmental impact statement, and it assesses whether the states have used their review and comment opportunities to increase state leverage and influence in energy decision-making.

43194 (RAND/R—2335-DOE) **Resolving environmental issues in energy development: roles for the Department of Energy and its field offices.** Ellickson, P.L.; Merrow, E.W. (RAND Corp., Santa Monica, CA (USA)). Jan 1979. Contract EX-76-C-01-2337. 62p. Dep. NTIS, PC A04/MF A01.

This study asks what the Department of Energy (DOE) might do to resolve environmental conflicts that arise during the implementation of energy projects or programs. We define implementation as efforts to establish an energy facility at a specific site. The environmental concerns surrounding implementation serve as touchstones of the relevance and feasibility of national energy policies. We have analyzed geothermal development in California and oil shale development in Colorado and Utah and addressed the following questions: By what processes are energy and environmental tradeoffs made? In what circumstances can DOE participation in these processes lead to a more satisfactory outcome? What options does DOE have for resolving environmetal issues and how can it choose the best option? How can DOE establish an effective working relationship with both the governmental and private groups affected by the siting and operation of energy projects? The government's most effective role in resolving environmental conflicts and uncertainties is to improve communications among the concerned parties. This role requires flexibility and evenhandedness from the government as well as an understanding of the local conditions and a commitment to appropriate local solutions. Involving local sources at every stage of the environmental impact analysis will reduce the probability of conflicts and make those that do arise more easily resolvable.

43195 (UCRL—15002) **Environmental aspects of alternative energy technologies for California.** Holdren, J.P.; Morris, G.; Tanenbaum, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1978. Contract W-7405-ENG-48. 167p. Dep. NTIS, PC A08/MF A01.

The following topics are discussed: cost-benefit analysis of energy impacts on biological, geophysical, and social environments; impacts of soft and transition technologies such as solar heat, on-site/central wind systems, waste/farm biomass systems, geothermal heat/electricity, hydroelectric dams, and fluidized-bed coal burners; observations on increased efficiency; and needs for further work. An appendix on biomass includes discussions of environmental impacts associated with the conversion of biomass to secondary energy forms, environmental impacts associated with use of fuels, and systems implications of biomass energy use. Environmental effects of hydropower are discussed in a second appendix. (HLW)

43196 **Large farm as a stereotype: a look at the Pacific Southwest.** Gregor, H.F. (Univ. of California, Davis). *Econ. Geogr.;* **55**: No. 1, 71-87(Jan 1979).

The results of a multivariate analysis of production factor inputs challenge several commonly held views of the large farm in the Pacific Southwest. No superfarm predominates, with several large-farm types being indicated. Nor do farms with large capital supplies and efficient management, the most important large-farm type, form a majority; they are also much less typical of operations in the larger and most productive agricultural regions than they are in areas closer to the city. Large farms in general also do not, despite wide distribution, dominate in the vast majority of counties. The information thus suggests that large-scale operations may not threaten smaller operators as much as assumed, and that urban growth may stimulate more than depress both farm productivity and efficiency, even in a region noted for the severity of competition for land. 25 references.

43197 **Multivariate-utility approach for selection of energy sources.** Ahmed, S.; Husseiny, A.A. (Iowa State Univ, Ames). *Energy (Oxford);* **3**: No. 6, 669-700(Dec 1978).

A deterministic approach is devised to compare the safety features of various energy sources. The approach is based on multiattribute utility theory (MAUT). The method is used in evaluating the safety aspects of alternative energy sources used for the production of electrical energy. Four alternative energy sources are chosen which could be considered for the production of electricity to meet the national energy demand: nuclear, coal, solar, and geothermal energy. For simplicity, a total electrical system is considered in each case. A computer code is developed to evaluate the overall utility function for each alternative from the utility patterns corresponding to 23 energy attributes mostly related to safety. The model can accommodate other attributes assuming that these are independent. The technique is kept flexible so that virtually any decision problems with various attributes can be attacked and optimal decisions can be reached. The selected data resulted in preference of geothermal and nuclear energy over other sources, and the method is found viable in making decisions on energy uses based on quantified and subjective attributes.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 42285, 42521, 42522, 42533, 42738, 43225

43198 **Urban residential demand for water in the United States.** Foster, H.S. Jr.; Beattie, B.R. (Texas A & M Univ., College Station). *Land Econ.;* **55**: No. 1, 43-58(Feb 1979).

The estimation of urban water demand has progressed from a requirements concept, to economic demand models in which the scope is limited to a homogeneous region and/or population, to generalized multivariate models covering the entire nation. This study presents a generalized model allowing for categorical effects due to regional and size-of-city differences on urban residential water demand. 26 references.

43199 **Statistical estimation of global mineral resources.** Marland, G. (Institute for Energy Analysis, Oak Ridge, TN). *Resour. Policy;* **4**: No. 4, 287-289(Dec 1978).

In this rejoinder to W.G.B. Phillips' article (Statistical Estimation of Global Mineral Resources, EAPA 4:2372) in the December 1977 issue of Resources Policy, Greg Marland argues that the paper contains fundamental mathematical deficiencies, presents a distorted view of global fossil-fuel resources, and propagates errors through citing defective intermediate references. W.G.B. Phillips in his reply attempts to counter most of the objections raised by Marland, and states many decisions on resources policy must be made using estimates of resource availability. Currently available estimates are not satisfactory and strongly reflect the interests of those who make them. (MCW)

43200 **Bureau of Economic Geology. 1978 annual report.** Austin, TX; Bureau of Economic Geology (1978). 39p. (NP—23739).

Bureau research programs and projects are designed to address many of the State's major concerns in the areas of geologic, energy, mineral, land, and environmental resouces. Research pro-

grams incorporate geologic concepts that will build toward an understanding of a specific resource and its impact on human activities. In addition to resource assessments in uranium, lignite, and geopressured geothermal energy, the Bureau continued research into analysis of governmental policy related to energy. Systemic geologic mapping, coastal studies, basin analysis projects, and investigations in other areas of economic geology further indicate the range of research programs carried forward in 1978. Specifically, research on mineral resources and land resources, coastal studies, hydrogeology, basin studies, geologic mapping, and other research (tektites and meteorites, carboniferous of Texas, depositional environments of the Marble Falls Formation, Central Texas) are reported. The establishment of the Mining and Mineral Resources Research Institute is followed. Contracts and grant support and contract reports are listed. The publications eminating from the Bureau are listed. Services rendered by the Bureau and personnel information are included. (MCW)

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 42588, 43200, 43215, 43239, 43240

43201 Annual report on energy research, development, and demonstration. Activities of the IEA, 1977—1978. Paris, France; International Energy Agency (1978). 69p. (NP—23768). OECD Publications and Information Center, Washington, DC.

The objectives of the IEA's energy research, development, and demonstration (R, D, and D) program are: the development of an R, D, and strategy; the fostering of effective national programs of R, D, and D through a process of national program reviews; and the establishment and conduct of cooperative energy R, D, and D projects in priority areas. This report describes the work underway in each of these activities. R, D, and D is being pursued in various IEA countries on: energy conservation technology, coal technology, nuclear safety, geothermal energy, solar energy (heating and cooling of buildings, electric power generation), biomass conversion, ocean energy systems, wind power, fusion power, and hydrogen production from water. Experiments in these areas and the participating countries or organizations are identified. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 42382, 42396, 42398, 42400, 42875, 42924, 42931, 42942, 43197, 44193

43202 (DOE/IR—0049) **Employment in nuclear energy activities, 1977: a highlights report.** (Department of Energy, Washington, DC (USA). Office of Education, Business and Labor Affairs). May 1979. 30p. Dep. NTIS, PC A03/MF A01.

In spite of the uncertainties in the nuclear energy field, employment in nuclear activities increased by nearly 15 percent between July 1975 and July 1977, according to the latest Bureau of Labor Statistics survey conducted for the Department of Energy. The survey covers employment in 21 industrial sectors comprised of Government-owned facilities operated by 57 private contractors and 874 privately-owned establishments, including 21 not-for-profit institutions. Not included in the survey are employees of Federal, state, and local governments; uranium mining; construction, except for reactors; medical institutions; or educational institutions not performing work connected with the Department of Energy. Informaion is presented by type of employer, Federal region, industrial sector, and size of establishment. 6 figures, 6 tables. (RWR)

43203 (NUREG—0548) **Selection and training of atomic safety and licensing board panel members: report to Congress.** (Nuclear Regulatory Commission, Washington, DC (USA)). Mar 1979. 240p. Dep. NTIS, PC A11/MF A01.

The Nuclear Regulatory Commission was authorized and directed to undertake a comprehensive review of the existing process for selection and training of members of the Atomic Safety and Licensing Boards, including, but not limited to, the selection criteria, including qualifications, the selection procedures, and the training programs for Board members. The findings of the review are detailed in the report.

43204 Fusion power: massive research program aims at formidable problems, almost limitless potential. Dingee, D.A. (Battelle Pacific Northwest Labs., Richland, WA). *Chem. Eng. News (Wash., D.C.);* **57**: No. 14, 32-47(2 Apr 1979).

This article surveys extensively fusion development under the following topics: US research directions; inertial confinement fusion; foreign fusion efforts; fusion issues; fusion applications; and arguments for fusion development. Dr. Dingee points out that, despite persuasive arguments for development, fusion has as yet attracted no substantial constituency; and that winning greater support for fusion may thus require a considerable technical breakthrough (namely, proof of scientific feasibility or achievement of energy breakeven) - or a new focus on an energy source such as hybrids, which offer a nearer-term payoff than pure fusion. Dr. Dingee says the next major facility for magnetic confinement research (to be built in late 1980s) has not yet been selected, but will probably be an engineering test facility; there are similar plans for inertial confinement. Whichever type is chosen, the first experimental power reactor is scheduled for the first few years of the 2000's, this to be followed by commercial demonstration of fusion power in the 2010 to 2020 time frame. He points out, finally, that the complex technical and institutional issues are being considered in a climate in which the benefits of nuclear energy itself are being questioned; and that there is little doubt that future development is tied to overall decisions the nation will make regarding the value of nuclear energy.

43205 Political implications of clustered nuclear siting. Meier, P.M. (Brookhaven National Lab., Upton, NY); Morell, D.; Palmedo, P.F. *Energy Syst. Policy;* **3**: No. 1, 17-36(1979).

The sociopolitical ramifications of nuclear energy centers, as emerging from a case study in Ocean County, New Jersey, are examined from the standpoint of identifying key issues of public controversy, and with emphasis on implications for national energy planning and the course of nuclear debate. Various dimensions of institutional tension are analyzed, including interstate issues and Federal preemption, and the ability of the institutional and political framework to address the many equity issues that are exacerbated by clustered siting. The evolution of public attitudes and the subsequent mobilization of effective political channels in opposition to proposed nuclear energy centers are discussed in light of the New Jersey experience. The degree to which energy centers affect public attitudes toward nuclear power is identified as the key issue requiring further analysis before widespread implementation of the concept can be advocated. 24 references.

TRANSPORT AND STORAGE

43206 (CONF-790455—2) **Understanding Federal transportation regulatory change: a study of one set of enrgy-transport policy-making mechanisms.** Bertram, K.M.; Bernard, M.J. III. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From Joint national meeting of the Institute of Management Sciences and the Operations Research Society of America; New Orleans, LA, USA (30 Apr 1979).

This paper presents informtion that may help transportation researchers to influence Federal actions on economic regulatory reform. Many papers report on the findings of studies made to analyze the implications of regulatory reform and then are immediately forgotten. This paper reports on an attempt to provide a means for avoiding this situation in a related regulatory change research area. First, it describes specific Federal agency policy-making channels in a major area of transportation regulation, namely energy materials transport. Then it suggests methods for stimulating these channels toward implementation of regulatory and legislative energy-conservation policies in this area. Because of the multi-modal pervasiveness of energy materials transport and today's increasing importance of transporation fuel costs, it is anticipated that understanding these policy-making channels and implementation techniques can also benefit transportation economic reform researchers. 17 references.

43207 Eighty atmospheres in reserve. *EPRI J.;* **4**: No. 3, 14-18(Apr 1979).

The compressed air storage (CAS) option can save one-half to two-thirds of the oil or gas used by a conventional gas turbine peaking system by using inexpensive grid electricity to run a combination motor-generator as a motor during off-peak hours to operate a compressor. Cooled, compressed air is pumped into an underground storage reservoir, where it remains at pressures up to 80 atmospheres until peaking power is needed. Research on CAS systems is aimed at reducing or eliminating the use of oil or gas to expand the compressed air. Storage reservoirs can be in salt, rock, or aquifer, each having its own advantages and disadvantages. Joint studies by the Electric Power Research Institute (EPRI) and DOE are examining the economic, safety, and environmental feasibility for combining CAS with utility systems.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 42157, 42300, 42305, 42737, 42841, 42842, 42843, 43279, 43326, 43327, 43328, 43329, 43330, 43331, 43332, 43333, 43335, 43339, 43340, 43341, 43342, 43343, 43344, 43502

43208 (CONF-7808102—, pp 20p, Paper 1) **Cogeneration and other interchange between industrial users and regulated suppliers.** Sherry, E.V. (Air Products and Chemicals, Inc., Allentown, PA). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Disparate competition between industry and utilities for steam- and electricity-supply investments is a cause of the relatively low industrial investments in self-generation. Risk differences between utility and industry markets, and the need to conserve capital, are explored to explain the differing rate of return requirements for energy-conservation and electrical-generation investments. In the absence of production investments, there is no opportunity for additional investments to improve energy efficiency. It is misleading to say that cogeneration does not occur merely because industry requires a higher return on such investments than on production investments. In some instances industry requires a lower rate of return on utilities for major plants. A broad definition of cogeneration is recommended as one of a list of 17 recommendations covering regulation, pollution, financial and tax policies.

43209 **Refuse-to-energy offers: co-generation opportunities.** Howard, A.H. pp 343-345 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

43210 **Potential benefits of co-generation.** Tibbetts, B. (Lowell Gas Co., MA). pp 349-351 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

CONSERVATION

REFER ALSO TO CITATION(S) 42300, 43251, 43277, 43314, 43318, 43319, 43320, 43321, 43328, 43329, 43330, 43502

43211 (DOE/TIC—10718) **Lender impacts upon energy conservation in buildings: development and assessment of alternative government actions.** Isakson, H.R.; Haney, R.L. Jr. (Georgia Univ., Athens (USA)). Feb 1977. 287p. Dep. NTIS, PC A13/MF A01.

This investigation identifies facets of the real-estate loan-underwriting process that inhibit or promote financing of energy-conserving devices and techniques in buildings; delineates government actions that would encourage private lenders to finance energy-conserving devices and techniques; estimates the financial institutions' probability of voluntary commitment to each of these government actions; and estimates the impact of each government action on future real-estate loan originations.

43212 (PB—287577) **Water/energy management and evaluation model for Pennsylvania. Completion report.** Elchak, T.L.; Raphael, D.L.; Ignizio, J.P.; Martinez, H.H. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Sep 1978. Contract DI-14-34-0001-7080. 146p. NTIS PC A07/MF A01.

An interactive water/energy model is presented for the state of Pennsylvania. An independent water model and energy model are joined to show the interactions between energy supply and demand with the supply of water. These interactions are depicted by water use functions for various energy sectors. Specific examples are presented for the electrical generation sectors. Two hypothetical scenarios are presented to show the use of the model as a planning tool.

43213 (PNL—2963) **Preliminary review of NECPA generated information requirements for the Office of Conservation and Solar Applications.** Rivera, R.G.; Nieves, A.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 8 Mar 1979. Contract EY-76-C-06-1830. 64p. Dep. NTIS, PC A04/MF A01.

Effective implementation of energy-conservation policy requires large quantities of various types of good-quality, timely data. To obtain the desired data, the information requirements must first be identified so that they can be communicated in a justifiable form to the Energy Information Administration (EIA) and other data-collecting organizations. This report represents the initial results of an effort to describe the general information needed by the Office of Conservation and Solar Applications (CS) to carry out their responsibility in implementing the National Energy Conservation Policy Act (NECPA). The assessment of the NECPA-generated information requirements is organized around the conservation programs for utilities, residences, industry, Federal and public buildings, and transportation. This assessment identifies the factors that generate the information requirements (sections, parts, and titles of NECPA), describes the general information needed to implement the act, and references potential sources of data. Appendix A contains a summary of this assessment in table form.

43214 **Thermal insulation and energy conservation.** *Heat., Piping Air Cond.;* **51**: No. 5, 49-58(May 1979).

Representative of various interests within the Heating/Piping/Air Conditioning industry participated in a roundtable discussion of the role of thermal insulation for piping and vessels in energy conservation. The group consisted of owners' engineers, contractors, consultants, manufacturers, fire protection engineers, and governmental representatives. The economic thickness concept is examined along with material considerations, installation techniques, fire protection, buying influences, and the decision-making process. This article is the first of two.

43215 **Effects of energy conservation research, development, and demonstration on residential energy use.** Hirst, E. (Oak Ridge National Lab., TN). *Energy Syst. Policy;* **3**: No. 1, 37-59(1979).

The Oak Ridge National Laboratory residential energy model is used to evaluate the energy use and direct economic effects of offering new residential energy-using technologies. These new technologies are assumed to be introduced as a consequence of government and private research, development, and demonstration (RD&D) programs. The energy savings resulting from the new technologies considered here increase from 0.1 QBtu in 1980 to 0.9 QBtu in 1990 and 1.9 QBtu in 2000. Present and projected RD&D programs sponsored by the Department of Energy (DOE) are expected to account for one-third of the cumulative energy saving of 20 QBtu. Because these new systems are more energy efficient than the conventional systems they replace, household fuel bills are reduced by $20 billion between 1977 and 2000. On the other hand, the higher initial cost of these advanced systems increases consumer costs on new equipment and structures. The net economic benefit to the nation's households is almost $18 billion. The DOE programs account for about 40% of this dollar saving.

43216 **Energy-related technical assistance guide for state grant programs. Volume I. Federal resources.** Neves, C.; Ellis, D.; Ellis, E.; Gadsby, G.N.; Walker, B.; Tarantino, T. McLean, VA; MITRE Corp. (1979). 251p. (MTR—7968(Vol.1)(Rev.1)).

The Guide is organized into two volumes: Federal resources and State resources. Both volumes consist of citation and index sections. The citation sections consist of brief descriptions of resources arranged under both Federal and State headings. Each citation gives the following information (where available) presented in the standardized sequence: State or Federal agency; program office; program name; program contact; program objectives; program description; target audience; experience with program; and additional information/comments. Federal resources are prefixed by the letter F, State resources by the letter S. For successive resources, digits are used as separators; further digits can be added as new information or additional resources are identified. The index section comprises four separate indices enabling the user to search for information under any one (or a combination) of the following categorizations:(1) subject; (2) program; (3) target audience; and (4) list of publications. Initially published in November 1978, this first revision incorporates additional data and updated material between then and May 1, 1979.

43217 **Energy-related technical assistance guide for state grant programs. Volume II. State resources.** Neves, C.; Ellis, D.; Ellis, E.; Gadsby, G.N.; Walker, B. McLean, VA; MITRE Corp. (1979). 350p. (MTR—7968(Vol.2)(Rev.1)).

This Guide has been prepared jointly by the Energy Extension Service and the State Energy Conservation Program to facilitate energy outreach program coordination and support. Its objective is to provide information on Federal and state sources of technical assistance and materials pertinent to both EES and SECP. In 1978, energy officials in 50 states and 6 territories were contacted in order to obtain brief descriptions of their EES programs in terms of those capabilities and accomplishments considered potentially useful to other states. This information is included in this volume, Volume II, which is arranged in loose-leaf format for easier updating. Recipients are encouraged to submit corrections, modifications, and new entries to Roland Kessler, Office of Techical Assistance,

Energy Extension Service, Mail Stop 2221C, U.S. Department of Energy, 20 Massachusetts Avenue, N.W., Washington, DC 20585. (MCW)

43218 (DOE/CS/1830—T3) **Department of Energy workshops on industrial energy conservation reporting.** (Washington Scientific Marketing, Inc., DC (USA)). [nd]. Contract EY-76-C-06-1830. 190p. Dep. NTIS, PC A09/MF A01.

A voluntary industrial energy-conservation program was initiated and now includes 50 trade organizations representing over 3,000 companies. Their current reporting system is an effort to respond to the Energy Policy and Conservation Act requirements, as now modified by the National Energy Conservation Policy Act. DOE's Office of Industrial Programs held six workshops in various key locations between November 1978 and February 1979 to enable energy managers to develop ideas and make suggestions that would improve the current and future energy-reporting programs. This report is a summary of the wide range of recommendations that the workshop participants offered as a means of meeting the NECPA requirements and the criticism of the current reporting program. It also reflects industry's views on potential approaches to future reporting. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 43174, 43177, 43182, 43229, 43234, 43241

43219 (AED-Conf—77-544-002) **Energy resources: shortness or abundance.** Rolshoven, H. (Ehrhardt und Sehmer G.m.b.H., Saarbruecken (Germany, F.R.)). 1977. 30p. (In German). (CONF-771271—2). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Congress on the development of energy demand and possibilities of supply; Berlin, F.R. Germany (5 Dec 1977).

Based on the figures of the World Nuclear Energy Conference 1977 and on the comparison of the world resources and need in energy raw material, the author states that the world resources of mineral energy raw material is sufficient to meet the demand on a long term basis. Due to the unequal distribution of need and raw material (especially in Europe and Japan), however, we must reckon with a shortage in the long term development. The political availability is, besides the economic availability, a factor that can be estimated only with difficulties. The shortage of energy sources can mainly be met by energy saving and finding of new sources. The basic model of the profitability calculation for a power-heat coupling is shown as an example for energy saving.

43220 (DOE/EIA—0182/3) **Distributional aspects of alternative energy-price scenarios.** Peabody, G.E. (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 54p. Dep. NTIS, PC A04/MF A01.

The tables in this report show selected distributional aspects of alternative energy-price scenarios. Estimates for high, medium, and low-price scenarios are given for 1990, estimates for medium prices are given for 1985, and comparable baseline estimates are given for 1975. The tables are from five different synthetic data files prepared and developed by simulations with the MATH/CHRDS model; tables from each file are in separate appendices. For 1990, there are three different energy-price scenarios: (1) medium world oil prices in Appendix A, (2) high world oil prices in Appendix B, and (3) low world oil prices in Appendix C. Appendix D contains tables for the medium-price case for 1985 and Appendix E has tables for 1975 with historical prices. For each scenario, the following tables are presented by fuel type (electric power, fuel oil and gas, coal, gasoline): median of expenditures by distributional group, median disposable income by distributional group, weighted population using each fuel by distributional group, mediam of expenditures as a percent of disposable income by distributional group, mediam of expenditures as a percent of disposable income by income class for each region, and median of expenditures as a percent of disposable income by urabn/rural for each region.

43221 (PB—287625) **Regional electric energy planning: a case study in the politics of scarce resources. Master thesis.** Birmingham, A. (Washington Univ., Seattle (USA)). 1976. 154p. NTIS PC A08/MF A01.

An attempt was made to examine the regional electric energy picture in the Pacific Northwest. Using the Bonneville Power Administration and Seattle City Light as the two major foci, the analysis discusses the past and present interaction of the regional electric energy planning entities.

43222 (RAND/R—2257-DOE) **Soviet energy balances.** Campbell, R. (RAND Corp., Santa Monica, CA (USA)). Dec 1978. Contract EX-76-C-01-2337. 115p. Dep. NTIS, PC A06/MF A01.

The pattern of energy flows in the Soviet economy contrasts sharply with that in the U.S. and in Western Europe. Today, the flow of energy exports in the USSR amounts to about 12% of Soviet primary energy production in 1975, whereas the U.S. and Western Europe must relay heavily on imports to augment domestic production. The composition of primary energy production in the USSR has changed considerably since 1950, when 80% was accounted for by solid fuel and only 18.5% by hydrocarbons. By 1975, hydrocarbons accounted for 64%, and the share for solid fuels had fallen to 33%. Since most Soviet energy exports have consisted of oil, the emphasis on solid fuels in consumption in the USSR is still higher than in production: solid fuels now represent 37% of consumption compared with 21% in Western Europe and 19% in the U.S. Within solid fuels, there is heavy reliance on relatively low-grade fuels: lignite, peat, oil shale, and firewod constituted nearly a third of Soviet solid fuel production in 1975. The demand and supply sides of the balance in the Soviet Union differ appreciably from that in the U.S. and Western Europe. Soviet energy policy has always had a special commitment to electrification, and this is expressed both in the high share of total fossil fuel that is converted to electric power and in the extensive use of by-product heat from power generation. These findings have a number of implications for Soviet energy policy makers as they try to save energy (especially oil) in order to maintan a high level of exports, and as an alternative to increasing their supply from the expensive trans-Ural sources.

43223 **Third World energy problems: the Chilean experience.** Trier, A. (INTEC-CHILE, Santiago). *Energy Policy;* 7: No. 1, 72-74(Mar 1979).

In common with other Third World countries, Chile's economy is burdened by the high cost of fuel imports. While much could be done to reduce imports through energy conservation and development of indigenous resources, government policy on energy has largely been limited to planning of investment needs. Industry seems generally unaware of the potential for fuel savings through more efficient operations, and no serious effort to conserve energy is expected in the near future. This article describes some of Chile's energy problems and reports on recent developments.

43224 **Missouri energy profiles.** Jefferson City, MO; Missouri Dept. of Natural Resources (1978). 272p. (NP—23738).

This is the third in a series of Profiles prepared by the Department of Natural Resources. DNR is also responsible for managing the state parks, air and water environmental quality, solid waste disposal, soil and water conservation, historical preservation, and geology and land survey. In 1977, it was decided that the thrust of the state's energy program should be to: promote the development of alternate sources of energy; plan for and be ready to respond to energy supply and/or distribution problems/ and encourage energy conservation. This third volume of the Profiles is intended to be a reference source for government decision makers and the energy producers and consumers of this state. Information is included on production and reserves of energy supplies (petroleum, petroleum products, natural gas, coal, electricity); energy consumption (energy consumption summaries, petroleum, natural gas, coal, electricity); energy prices; energy related data (Missouri County and metropolitan area population estimates, Missouri monthly heating degree days, mean daily solar radiation, state motor fuel tax receipts, state motor vehicle registrations, motor vehicle travel in Missouri by type of highway system, residential, appliance saturations, residential appliance detail report, energy interstate shipments and imports). (MCW)

43225 **Interim plan for the emergency management of energy resources. Volume IVa.** Richmond, VA; Commonwealth of Virginia (1977). 126p. (NP—23770).

This Interim Plan for the Emergency Management of Energy Resources was undertaken to be implemented during the winter of 1977 if needed. It will ultimately become a part of an overall State Plan that will address shortages of all classes of essential resources in peace and war. The Plan assigns management responsibilities and provides policy guidance and procedures for the conservation, distribution, and use of limited energy resources in a shortage situation. It also provides for assistance to individuals and families unable to obtain home heating and cooking fuels or who suffer economic hardship in an energy crisis. Guidance on preparation of local government plans have also been included in the Interim State Plan. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 42274, 42311, 42530, 42531, 43184, 43193, 43203, 43206, 43222, 43233, 43272, 43772, 43828, 43829

43226 (DOE/TIC—10067) **Managerial plan: Executive Order 12003 and the National Energy Act.** (Unified Industries, Inc., Alexan-

dria, VA (USA)). Dec 1978. Contract EM-77-C-01-8962. 96p. Dep. NTIS, PC A05/MF A01.

This managerial plan was developed to provide both DOE and other affected agencies a tool to assist in planning and developing the Federal Energy-Conservation Program established by Executive Order 12003. This order requires that, by 1985, Executive Branch agencies that own or will own buildings reduce building energy-consumption substantially below 1975 levels. The order also requires that all agencies of the Branch conduct programs designed to reduce energy consumption in general operations of the agency. This Managerial Plan incorporates the thrust of the recently enacted National Energy Conservation Policy Act. The plan is composed of three major parts: (1) Program Master Plan (Chap. 3) describes goals, objectives, strategies, and milestones within a structure that describes the framework, elements, phases, and roles of the agencies; input/output schematic charts are used wherever appropriate to provide a visual analysis of the time-sequence flow of activities; (2) a Data Plan (Chap. 4) describes data requirements for the planning, implementing, evaluating, and reporting functional requirements of the executive order; and (3) a Management Plan (Chap. 5) provides an analysis of the DOE organizational management and resource requirements necessary to effectively carry out the functions contained in EO 12003. Organizational details pertinent to the Federal Program Office are included in appendixes A and B.

43227 (DOE/TIC—10118) **Summary of major energy legislation of the 95th Congress.** (Department of Energy, Washington, DC (USA). Div. of Legislative Research and Analysis). Dec 1978. 158p. Dep. NTIS, PC A08/MF A01.

The title, sponsor, synopsis, and legislative status of major energy lesiglation of the 95th Congress includes the following subjects: Alaska lands, Alaska gas transportation, antiboycott legislation, backhauling, Canadian fuel imports, cargo preference/tanker safety, Clean Air Act, coal conversion, coal leasing, coal slurry pipelines, cogeneration, dealer protection, Department of Energy (organization), DOE FY 79 appropriations and authorizations, divestiture, electric energy and utilities, energy conservation, energy impact assistance, Energy Policy Institute, ERDA FY 78 authorizations, ERDA/FEA FY 78 appropriations, enhanced oil recovery, environment and safety, FEA FY 78 authorization, fuels transportation safety, gasohol, geothermal energy, insulation standards, liquefied natural gas, mine safety, National Energy Act, natural gas, nuclear energy, nuclear siting and licensing, nuclear waste management, oil and gas leasing, oil import fees, oil pollution liability, oil shale commercialization, outer continental shelf, pipeline destruction, Safe Drinking Water Act, solar energy, state energy management program, strip mining, and uranium mill tailings.

43228 (NP—23747) **Considering the second update of the German Federal Government's energy program.** (Bundesverband der Deutschen Industrie, e.V., Koeln (Germany, F.R.). Abt. Energie- und Atomwirtschaft). Mar 1977. 21p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

Before the publication of the second update of the energy program, the Bundesverband der Deutschen Industrie (BDI) presents in this document a number of items concerning this subject which, from a general industrial point of view, have to be clarified first: contradiction of short- and long-term development; taking precautions in case of crises; rational energy utilization; power/heat coupling; structural problems of petroleum supply; contribution of pit coal; delays in using nuclear energy; and international cooperation.

43229 **United States' energy policy: Administration's strategy.** O'Leary, J.F. (U.S. Dept. of Energy, Washington, DC). *Nat. Resour. Lawyer;* **11**: No. 4, 625-632(1979).

A superficial interpretation of U.S. energy consumption statistics overlooks the history of energy use and technology based on easily and cheaply exploited energy sources. Granting that errors have been made, the mid-1980s are forecast to reflect higher energy costs, price-induced energy conservation, and a slower growth in gross national product. Initiatives in the housing and transportation sectors and changes in the fuel mix are cited to support this view. Expansion in energy production will follow the development of conventional and nuclear fuels, which will require prompt resolution of licensing, siting, and other regulatory policies. An orderly expansion is underway to develop and demonstrate new energy technologies in preparation for the next century.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 42231, 43200

43230 (DOE/ET—0087) **Fossil energy program summary document.** (Department of Energy, Washington, DC (USA)). Mar 1979. 484p. Dep. NTIS, PC A21/MF A01.

The programs and projects involving the fossil energy resources of the United States (coal, petroleum, natural gas, and oil shales) are described in detail. The primary emphasis of the Fossil Energy Program is on coal, the most abundant natural resource. Activities in this area include mining research and development, coal liquefaction and gasification, advanced environmental control technology, heat engines and recovery, combustion systems, fuel cells, and magnetohydrodynamics. For petroleum the activities stressed are enhanceed oil recovery, oil shale technology, drilling and offshore technology, and advanced process technology. For natural gas the emphasis is on recovery from unconventional sources such as tight sandstones and shales. Commercialization, environmental, and socio-economic issues involved in these activities are of prime consideration. The contributions of the energy technology centers and national laboratories to the overall goals of the Fossil Energy Program are summarized. International programs on the production and utilization of fossil fuels are described. The requested funding for FY 1980 is $747.6 million, of which $662.7 million is planned for coal, $57.4 million for petroleum, and $27.6 million for gas. (JSR)

COAL

REFER ALSO TO CITATION(S) 42158, 42240, 42269, 42273, 42274, 42514, 43186, 43187, 43197

43231 **Coal gasification for electric utilities.** *EPRI J.;* **4**: No. 3, 6-13(Apr 1979).

Technological improvements in coal gasification processes have lessened environmental impacts and increased efficiency enough to bring gasifiers linked with electric utilities into the range of economic feasibility. A comparison of gasification versus atmospheric combustion shows the relative volumes of oxidant, steam, gases, and waste products. The pressurized gasification process involves less structure (economizing on both materials and site) and requires a lesser volume of initial oxidant. The volume of gas from which potential pollutants are removed as hydrogen sulfide and ammonia is smaller and requires smaller extraction equipment. A major related advantage is the absence of scrubber sludge waste. The product gas going into combustion is clean.

43232 **Coal cleaning plus scrubbing proves economic desulfurization combination.** Cole, R. *Electr. Light Power (Boston);* **57**: No. 4, 25-26(Apr 1979).

The combination of coal cleaning and flue-gas desulfurization can be a better choice than scrubbers alone. An analysis of sulfur and ash removal for three coal types, West Kentucky No. 9, 11, and 12, shows that precombustion cleaning reduces the capital investment and operating costs for the scrubber's absorbent handling and preparation system and for sludge disposal. Generally, the savings cover the cost of the coal preparation plant. If the EPA requires chemical fixation of scrubber sludge, the economics will tilt more in favor of the combination of precombustion cleaning and flue gas desulfurization. The greatest potential savings attributable to coal cleaning, however, are reduced maintenance costs and increased rated capacity. Precombustion cleaning would allow an increase in availability and capacity and reduced operating costs. Recently proposed EPA regulations preclude the use of coal cleaning alone as a method for complying with sulfur dioxide standards in new electric utility boilers. However, coal cleaning with scrubbers may be used in some cases as a cost-effective method of meeting the revised New Source Performance Standards.

PETROLEUM

REFER ALSO TO CITATION(S) 42276, 42277, 42278, 42285, 42300, 42303, 42304, 42305, 42309, 42311, 42312, 42313, 42315, 42319, 42320, 43271

43233 (EMD—78-73) **Federal regulation of propane and naphtha: is it necessary.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 24 Oct 1978. 51p. General Accounting Office, 441 G Street, NW, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

Propane, naphtha, and other petroleum-based products were regulated in 1973 because the oil embargo threatened to create a national shortage. It never developed. As a result, some products were deregulated. However, DOE continues to regulate propane and allocate naphtha used to manufacture synthetic natural gas even though supplies have been adequate to meet demand. Propane shortages have resulted from distribution problems rather than a national supply shortage. Such shortages could be handled through improvements in the State set-aside program. The Department should take the required steps to exempt propane from allocation regulation. One of the National Energy Plan's objectives is to increase short-term production of synthetic natural gas. Goals should

be established for such production. To meet them, DOE should also take the required steps to deregulate the allocation of naphtha.

NATURAL GAS

REFER ALSO TO CITATION(S) 42285, 42328, 42336, 43271

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 43185

ELECTRIC POWER

REFER ALSO TO CITATION(S) 42527, 42530, 42531, 42830, 43231, 43271, 43273

43234 (BNL—50962) **Regional Reference Energy Systems: electric utility applications.** Hermelee, A. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Jan 1979. Contract EY-76-C-02-0016. 106p. Dep. NTIS, PC A06/MF A01.

Reference Energy Systems (RES) were developed for the region serviced by the Tennessee Valley Authority (TVA) for the base year 1975 and projections developed for the years 1980, 1985, and 2000. This system's formulation has traditionally been applied to assessment of energy technologies and policies on a national level. A reformulation of the projection methodology is presented in order to apply the RES format to an electric utility region (e.g., the TVA). The RES is a network representation of technical activities required to supply various forms of energy to end-use activities. Technologies are defined for all operations involving specific fuels including resource extraction, refinement, conversion, transportation, distribution, and utilization. Each of these activities is represented by a link in the network for a given year with the levels of energy demand and supply specified. A unique advantage of using the RES for utility planning is its integrative view of the entire energy system as opposed to an analysis limited exclusively to the electric sector. This system's approach, incorporating all resources, technologies and uses of energy, allows a utility to assess the impact of alternate technologies and policies across the entire energy system. Demand patterns for 25 end-use demand categories within the residential, commercial, industrial, and transportation sectors are developed for a base-case scenario representing reasonable energy-use patterns derived in a consistent manner by applying engineering techniques to the best available information. The impact of a new technology in terms of resource consumption may be evaluated by modifying the energy-flow paths to incorporate the new technology. Alternate paths through the network reflect the substitutability of resources and technologies for one another.

43235 (DOE/EIA—0183/2) **Sensitivity of electric utilities dispatch model in the midterm energy market model. Technical report.** Eynon, R.T. (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1979. 35p. Dep. NTIS, PC A03/MF A01.

This report analyzes the sensitivity of the electric utilities process model in the Midterm Energy Market Model. Sensitivity has been measured by varying critical parameters in the utilities submodel to determine impacts on fuel mix, capital expenditures, electricity demand, and dispatching patterns. These results provide insight into the uncertainty of the forecasts due to changes in assumptions for operating environment. The responses elicted from the model assume no change in institutional structures or regulatory practice. The what if tests applied here are the only changes assumed that affect the operating environment of utilities. This restriction allows the impact of each change to be displayed separately. Tests were made with the following assumptions: the sensitivity of existing- and new-plant dispatch, plant-performance variations, changes in project-completion schedules, uncertainties in capital costs, coal-supply cost variations and reserve-margin assumption changes. The bulk of the report provides a detailed analysis of the impacts of each of these changes.

43236 (DOE/ERA—0053) **United States/Canada electricity exchanges.** (Department of Energy, Washington, DC (USA); Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Feb 1979. 233p. Dep. NTIS, PC A11/MF A01.

The United States and Canada have been cooperating in all areas of energy exchange for many years. Electrical energy has been chosen to be the focus of this study because substantial means for exchanges offer benefits that have not yet been fully exploited. There may be some bilateral benefits from additional interconnections because of the buffers which they represent against domestic imbalances. After the history of the electricity exchanges between the two countries is reviewed, opportunities and incentives and obstacles and constraints are discussed in the next two chapters. The final chapter examines procedures to resolve obstacles and minimize constraints. (MCW)

43237 (DOE/TIC—10803) **Energy rate initiatives: study of the interface between solar and wind energy systems and electric utilities.** (Federal Energy Administration, Washington, DC (USA)). 31 Mar 1977. 123p. Dep. NTIS, PC A06/MF A01.

Under Title II - Electric Utility Rate Design Initiatives - of the Energy Conservation and Production Act (P.L. 94-385), the Federal Energy Administration was required to submit to Congress reports identifying possible actions that could be taken to (1) minimize costs of electric energy to consumers, (2) minimize the need for new electrical-generating capacity, (3) encourage energy conservation, and (4) motivate better use of existing electrical generating facilities. The implementation of alternative utility rate structure could easily impact the economics of future solar heating and cooling of buildings (SHACOB). It is expected that such variations in SHACOB economics may affect the design of these systems and their rate of market penetration and ultimately impact the backup energy load that they place on the utilities. This report discusses the problem in terms of seven key issues, and suggests seven possible actions government and regulatory bodies may wish to consider.

43238 (HCP/B8681—01/4) **Institutional analysis of alternative electric rate designs and related regulatory issues in support of DOE utility conservation programs and policy. Volume IV. Institutional analysis.** (ICF, Inc., Washington, DC (USA)). May 1979. Contract EM-77-C-01-8681. 261p. Dep. NTIS, PC A12/MF A01.

An attempt is made to study the potential institutional and legal problems with regard to the implementation of alternate electric-rate designs. The report analyzes three rate forms: residential demand-energy rates, residential load-management rates, and rates for solar-backup systems. The status of these proposals for Wisconsin, Texas, Ohio, Oregon, North Carolina, and New Jersey is studied. Section II reviews the problems in connection with the implementation of various alternate electric rate designs. Section III addresses the possibility that preferential or discriminatory rates may be advocated by some parties in order to encourage the implementation of solar energy devices, demand energy rates, load-management devices, and co-generation proposals. Detailed individual analyses of each state are made in Section IV. Reviews are made of the statutory framework relating to public utilities, the effects of newly enacted legislation, past commission decisions and court decisions construing the relevant statutes. Also reviewed is the manner in which the utility commissions have implemented dem-energy rates, load-management devices, co-generation proposals, and tariffs dealing with solar energy. (MCW)

43239 **Challenges of the next decade.** Culler, F. (Electric Power Research Inst., Palo Alto, CA). *EPRI J.;* **4**: No. 1, 5-7(Jan 1979).

The challenges that EPRI and utilities will face in their effort to develop new technologies and new energy sources that will supply electricity for an expanding population is outlined. The strategy, which will assume a total increase and a slower growth rate for employment and gross national product as well as a growth in population, will focus 45% of the effort on the immediate, 45% on the mid-term and 10% on the long-term problems. Annual review will be made of the processes and fuels used to generate electricity and efforts will be made to balance energy demand with conservation. Environmental and health protection have led to about half of the R and D programs and have made EPRI a major contributor to the field.

43240 **Scanning the research agenda.** *EPRI J.;* **4**: No. 1, 8-27(Jan 1979).

Thirty representative projects are summarized to indicate the scope of the Electric Power Research Institute's (EPRI) research activities. Supply and demand modeling is essential to utility planning, as are probabilistic studies and computer code development for plant safety and engineering. Fuel studies for power generation include coal (gasification for combined cycle, liquefaction, and fluidized-bed combustion), nuclear fusion, solar heating and cooling, and direct-conversion fuel cells. Environmental and health projects include regional monitoring of sulfates, animal toxicology, clinical studies of pollutants, effects of cooling systems and high-voltage, and radiation control. Power plant operation studies examine scrubbers, human factors in plant reliability, seismic tests, and fuel improvement. Also described are projects associated with developing and testing new materials and developing new technology for delivering energy.

43241 **Price expectations and the demand for electric energy.** Uri, N.D. (Dept. of Energy, Washington, DC). *Energy Syst. Policy;* **3**: No. 1, 73-83(1979).

Given the variability of the price of electrical energy over the past several years, the consumer has been put in a position of not

knowing precisely from one month to the next what will be the price of electrical energy. Consequently, this paper hypothesizes a relationship between the expected price and kilowatt-hour sales. The results indicate that static expectations seem to be the rule with regard to price and that almost 70% of price changes are regarded as permanent by consumers. 11 references.

43242 Tennessee Valley Authority financial statements for the fiscal year ended September 30, 1978. Knoxville, TN; Tennessee Valley Authority (1978). 45p.

The financial statements of the TVA for the years ended September 30, 1978 and 1977 are presented. They are accompanied by a report thereon by Coopers and Lybrand, independent certified public accountants. Tabulated data appear for financial statements (balance sheets, statements of operations, changes in financial position). Notes to financial statements appear. The accountants then report that the statements present the data fairly. Tabulated data present schedules containing details of property, plant, and equipment; power expense; nonpower net expense; operating expenses of multiple-use facilities; and administrative and general expenses. (MCW)

43243 Tennessee Valley Authority power annual report for the fiscal year ended September 30, 1978. Knoxville, TN; Tennessee Valley Authority (1978). 40p.

TVA supplies power at wholesale to 160 municipal and cooperative distributors and one privately owned electric system which in turn distribute power to about 2.7 million customers in part of seven states. TVA also supplies power directly to 50 individual industrial customers with large or unusual power requirements and several Federal nuclear, aerospace, and military installations. Financially, the power program is separate from other TVA programs. It is required to be self-supporting and self-liquidating. This report deals with TVA's electric power activities. The TVA Act sets the objective of keeping electric rates as low as feasible, but specifies that rates are to be set at levels which will cover power system costs and financial obligations. Final operating results in the perspective on 1978 show TVA revenues did cover such costs, but the margin of revenues over revenue requirements was slightly less than the amount considered desirable in relation to the power system's fixed obligations and capital requirements. Summaries of sales, revenues, earnings, borrowings, rates, load management, solar energy, energy conservation, fuel and power supply, and energy research are included. A map of the power system is given. (MCW)

43244 Glossary: electric-utility ratemaking and load-management terms. New York, NY; Edison Electric Inst. (1978). 86p. (NP—22572). Electric Power Research Inst., Palo Alto, CA.

This Glossary suggests practical definitions of principal terms used by the electric utility industry, particularly in rate making. The glossary was prepared for all types of users, including utility personnel and regulators in their considerations of electric utility rate making; both financial and technical terms have been included. (MCW)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 42520, 42521, 42522, 42526, 42528, 42529, 42533, 42844, 42848, 43207, 43232, 43252, 43315

43245 (EPA/600/9—78-013) **Comprehensive standards: the power generation case.** (Teknekron, Inc., Berkeley, CA (USA). Energy and Environmental Engineering Div.). Jun 1978. 372p. NTIS, PC A16/MF A01.

Repots are included on fuel cycles for electric power generation, water reactor fuel cycles, gas-cooled reactor fuel cycles, and fuel cycles for combustion combined cycle power plants. A separate abstract was prepared for each report. (JRD)

43246 (EPA/600/9—78-013, pp 237p, EEED 101) **Fuel cycles for electric power generation.** Pigford, T.H.; Keaton, M.J.; Mann, B.J.; Cukor, P.M.; Sessler, G.L. Jun 1978.

In Comprehensive standards: the power generation case.

An illustrative data base is presented of material quantities and environmental effluents in the fuel cycles for alternative technologies of thermally generated power. The entire fuel cycle for each of ten alternative technologies is outlined for a representative power plant generating 1000 Mw of electrical power. The required utilization of material resources and the fuel cycle material quantities are indicated on a flow sheet for each technology. The technologies considered include: light-water nuclear reactors, coal, residual fuel oil, natural gas, geothermal steam, breeder fission reactors, solar energy, and thermonuclear fusion.

43247 (PB—287623) **The development of the electrical power system in the Pacific Northwest, a public policy perspective. Masters thesis.** Walton, R.G. (Washington Univ., Seattle (USA)). 1976. 185p. NTIS PC A09/MF A01.

The objective is to provide a description and analysis of the development of the electrical energy system in the Pacific Northwest from the late 1950's to 1976, from a public policy perspective. Unprecedented changes have appeared in the electrical energy picture in the PNW in recent years, and the near future promises to produce additional decisions of significant importance to the region. The arrival of large capacity thermal-electric power plants in the region (both coal and nuclear), and plans for many more, have been accompanied by greatly increased public attention to energy and the environment. The controversies that have ensued are complex, and the manner in which they are to be resolved is of great interest and concern to a large number of individuals and organizations. In spite of these facts, however, the level of citizen awareness of the region's plans for electrical power development, how these plans have been chosen, and by whom, appears to remain at a very low level. Considerable attention has been given to the historical evolution of the regional power system. This has helped to place the present dilemma in context, as the requirements placed on electric energy planners have evolved with the growth in generation and use of electricity.

43248 Interfuel substitution possibilities: short-term prospects. Uri, N.D. (Dept. of Energy, Washington, DC). *Appl. Energy;* 4: No. 4, 251-260(Oct 1978).

This paper applies a translog price possibility frontier in order to measure the extent of interfuel substitution effects in the electric power industry in the United States. The results suggest that relative changes in fuel prices have significant effects on fossil fuel consumption. This, in turn, has important implications for public policy. In particular, the market system appears better able to deal with exogenous shifts in energy supplies than has frequently been assumed in the formulation of public policies with respect to the energy crisis.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 43226, 43287, 43290, 43313, 43318

43249 (TID—29429) **Preparation and development of land-use energy-consumption data sets. Task 1: development of a proposed land-use classification system.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). 6 Jan 1978. Contract EC-77-C-02-4528. 136p. Dep. NTIS, PC A07/MF A01.

This is the first interim report of Phase I of the contract Preparation and Development of Land-Use and Energy-Consumption Data Sets; it describes the first of five sections of the project, namely development of the conceptual structure to be used in analyzing the relationships betwen community land-use patterns and aggregate energy consumption. Following a brief introduction Chapter 2 describes the purpose of the project and its objectives, suggestions of potential users for the data sets as developed, some of the limitations of research, ans some assumptions that have ben made in developing the structure. Chapter 3 provides a description of the types of energy use of interest to the project and some suggestions on where the project resources should be concentrated. chapter 4 is concerned with the independent variables, which are hypothesized to affect eenergy use. Chapter 5 provides a preview into Tasks 3 and 4 which are concerned with aggregating parcels into communities and reviewing the existing data. Appendixes A and B give lists of documents that have been gathered by the staff and interviews that have been performed.

43250 Energy use in Hawaii. Honolulu, HI; Hawaii State Dept. of Planning and Economic Development (1977). 52p. (NP—23778). State Energy Office, Honolulu, HI.

Statistical exhibits are used to aid in the discussion of energy use in Hawaii. These exhibits include: U.S. Petroleum Milestones; Sources of Energy (Hawaii and U.S.); Petroleum Consumption by Fuel Types (Hawaii and U.S.); Petroleum Shipping Patterns in Hawaii; Hawaii Petroleum Consumption by Economic Sector; Petroleum Products Delivered in Hawaii; End Use of Residential Energy (Hawaii and U.S.); Hawaii's Largest Civilian Users of Energy; Electricity Generating Capacity by Energy Source; and Electric Generation: Capacity and Total 1975. Energy data are presented in detailed figures and tables for the following categories: General (state consumption, petroleum, population, deliveries); electricity (state generation, electric utilities, residential energy use, sugar mill production data and energy use); gas (utilities (number of utilities and gas utilities delivery data); and gasoline (gallons per motorist, delivery, vehicle trend, prices). (MCW)

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 43197

43251 **Energy strategy: soft vs. hard technologies.** Lovins, A.B. pp 31-40 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The disadvantages of hard energy technology (centralized electrification) are reviewed: energy losses in big systems, lack of economy in big systems, energy losses in transmission, reliability, vulnerability to outside influences, and environmental effects. The advantages of soft technology are discussed, such as development by small businesses and meeting basic human needs - heating, cooking, lighting, pumping - rather than supplying a costly high-technology form of energy with imported, capital-intensive, high-technology systems. Energy use in the U.S. and Canada are compared. Some arguments against nuclear energy are presented. (MHR)

SOLAR

REFER ALSO TO CITATION(S) 42545, 42552, 42553, 42557, 42643, 42668, 42673, 42677, 42745, 42746, 43237

43252 **TPV: management approach to high-risk research.** *EPRI J.;* **4**: No. 3, 19-22(Apr 1979).

The Electric Power Research Institute (EPRI) is investigating the still unproven concept of thermophotovoltaic conversion (TPV), which shows possibilities of a higher efficiency than thin films and lower costs than single-crystal silicon cells. A TPV system concentrates and changes visible light to infrared energy, which is then converted to electricity by a single-crystal silicon cell. EPRI research is studying optical and thermal performance, radiator materials, and system design. Utility interaction during the research stage will increase the development of ideas for improving performance and integrating the concept into a utility network. The concept can be applied to heat sources other than sunlight and would, when used with a fossil-fueled system, involve fewer moving parts than conventional steam turbines.

GEOTHERMAL

REFER ALSO TO CITATION(S) 43200

OTHER

REFER ALSO TO CITATION(S) 42527, 42655, 42812, 42813, 42834

ENERGY CONVERSION

43253 **State of research and prospects for direct conversion of various forms of energy into electric energy.** Lidorenko, N.S. *Sov. Electr. Eng. (Engl. Transl.);* **48**: No. 11, 24-29(1977).

A brief survey of the research carried out by the All-Union Scientific Research Institute for Current Sources on various electric generating devices is presented. In particular, various photoconverters, solar cells, thermogenerators, chemical cells and batteries are briefly described. Utilization of direct conversion systems in data processing elements is surveyed.

MHD GENERATORS

REFER ALSO TO CITATION(S) 43600

DESIGN AND DEVELOPMENT

43254 (CONF-781009—, pp 61-84) **Preliminary summary of the ETF conceptual studies.** Seikel, G.R. (NASA, Lewis Research Center, Cleveland, OH); Bercaw, R.W.; Pearson, C.V.; Owens, W.R. 1978.

From 4. US-USSR colloquium on MHD electric power generation; Washington, DC, USA (5 Oct 1978).

Results of the recently completed Engineering Test Facility (ETF) studies are reviewed. These three parallel independent studies were conducted by industrial teams led by the AVCO Everett Research Laboratory, the General Electric Corporation, and the Westinghouse Corporation. A preliminary analysis and the status of the critical evaluation of these results are presented.

43255 (FE—1760-31) **Development program for MHD direct coal fired power generation test facility. Annual technical progress report, January—December 1977.** Dicks, J.B. Jr.; Markant, H.P.; Attig, R.C. (Tennessee Univ., Tullahoma (USA). Space Inst.). 15 Mar 1978. Contract EX-76-C-01-1760. 172p. Dep. NTIS, PC A08/MF A01.

Tests conducted in the existing MHD facility supported areas critical to the design of test components for the new intermediate-size, direct coal fired MHD development facility. Experimental results provided evidence as to what the flow train downstream of th generators and diffuser for the new facility should contain. SO_2 emissions at the exit of the MHD were reduced by about 80 to 85% as the amount of seed addition increased. Test results of NO/sub x/ measured at the cyclone separator exit indicate that NO/sub x/ levels can be reduced from 3,000 ppm to less than 50 ppm by properly controlling the oxygen-to-coal ratio. A vitiation heater and combustor combination was designed and constructed. The integrity of the water-cooled coal injector tube concept planned for the combustor proved to be sound. Two series of MHD generator experiments were carried out under direct coal-fired conditions. One series investigated the effect of multiple resistive loads and the other investigated the generator performance as a function of the type insulation used between electrodes. Development of the data acquisition system has produced a basic capability for on-line data acquisition, reduction, and display. Inverter development investigated noise modulation on the D.C. output from the MHD channel. The status of the design and construction of the new direct coal-fired prepilot size MHD development facility is reported. The materials program reports on insulator studies and chemical and fuel technology.

43256 (TID—28967) **CDIF operational modeling status report. Quarterly progress report, October—December, 1977.** (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 31 Dec 1977. Contract EF-77-C-01-2524. 18p. Dep. NTIS, PC A02/MF A01.

The Operational Modeling Task consists of the development of computer programs to model the integrated CDIF. The goal of this effort is to predict facility operating characteristics. For example, when the operator makes a particular adjustment in the firing rate to the metallic air preheater, this software should tell him what changes to expect throughout the system. The overall status of the modeling task is summarized, and detailed information on the input and output for the various programs is appended. (WHK)

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 43254

43257 **Role of interfacial heat and mechanical energy transfers in a liquid-metal mhd generator.** Fabris, G.; Pierson, E.S. (Argonne Natl Lab, Ill). *Am. Soc. Mech. Eng., [Pap.];* No. 78-WA/HT-33, 1-8(1978).

A brief description of the two-phase liquid-metal MHD power generation cycle and its advantages is provided. The importance of good interfacial liquid to gas heat transfer is discussed, and data confirming that satisfactory heat transfer is indeed achieved in an experimental generator is presented. An expression for the effect of the velocity difference between the gas and the liquid on generator performance is derived. An "equivalent turbine" efficiency is defined to characterize the generataor as part of a heat engine and related to experimental data.

MATERIALS, COMPONENTS, AND AUXILIARIES

43258 (COO—4049-1) **Operation and maintenance of DOE/PETC two-stage MHD pressurized coal combuster. Annual activity report, July 1, 1977—July 14, 1978.** (Management and Technical Services Co., Philadelphia, PA (USA)). 15 Aug 1978. Contract EY-76-C-02-4049. 47p. Dep. NTIS, PC A03/MF A01.

A description of the operation, problems, and modifications in the development of the pressurized coal combustor is presented in chronological order. The pulverizer, conveyor, dryer, cooling systems, and combustor were instrumented and tested. (WHK)

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 44137

THERMOELECTRIC GENERATORS

REFER ALSO TO CITATION(S) 43253

FUEL CELLS

REFER ALSO TO CITATION(S) 43253

MATERIALS, COMPONENTS, AND AUXILIARIES

43259 (CONF-780952—46) **Superconducting dipole magnet for the UTSI MHD facility.** Wang, S.T.; Niemann, R.C.; Turner, L.R. (Argonne National Lab., IL (USA); General Atomic Co., San Diego, CA (USA); Wisconsin Univ., Madison (USA); Cryogenic Consultants, Inc., Allentown, PA (USA)). 1978. Contract W-31-109-ENG-38. 31p. Dep. NTIS, PC A03/MF A01.

From Applied superconductivity conference; Pittsburgh, PA, USA (25 Sep 1978).

The Argonne National Laboratory is designing and will build a large superconducting dipole magnet system for use in the Coal Fired Flow MHD Research Facility at the University of Tennessee Space Institute (UTSI). Presented in detail are the conceptual design of the magnet geometry, conductor design, cryostability evaluation, magnetic pressure computation, structural design, cryostat design, the cryogenics system design, and magnet instrumentations and control.

43260 (COO—2927-1) **Evaluation of fuel cell electrolytes for direct and indirect oxidation of carbonaceous fuels. Final report, April 1, 1976—March 31, 1978.** Austin, L.G.; Pickering, H.W.; Ateya, B.G.; Rebert, N.; Poweigha, T. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Mar 1978. Contract EY-76-S-02-2927. 40p. Dep. NTIS, PC A03/MF A01.

The objective of this research program is to find an electrolyte for direct or indirect oxidation of carbonaceous fuels in a fuel cell in which the electro-oxidation rates of hydrogen or the carbonaceous fuel are greater than when 85% H_3PO_4 is used as the electrolyte. The main tasks include: (1) measurements of electrical resistivity of the electrolytes at various temperatures; (2) measurement of vapor pressure at various temperatures; and (3) measurements of fuel oxidation and oxygen reduction rates at rotating disk electrodes and gas diffusion electrodes in the selected electrolytes at various temperatures. The following electrolytes were evaluated and their performance was compared to that of 85% H_3PO_4 at 135°C: pentafluoropropanoic acid, trichloroacetic acid, chlorodifluoroacetic acid, methane disulfonic acid (50 wt % aqueous solution), methane sulfonic acid, benzoic acid, and benzene sulfonic acid. Many of these acids performed very poorly; the only one that proved to be superior to 85% H_3PO_4 is the methane sulfonic acid.

43261 **Properties of trifluoromethanesulfonic acid monohydrate pertinent to its use as a fuel cell electrolyte.** Sarada, T.; Granata, R.D.; Foley, R.T. (Am Univ, Washington, DC). *J. Electrochem. Soc.;* **125**: No. 12, 1899-1906(Dec 1978).

The electrical conductivities of monohydrate-water mixtures were compared with those of sulfuric acid and phosphoric acid. All three systems show a maximum in the conductivity-composition curve with that of the monohydrate-water system falling at 40-45% of the monohydrate. Trifluoromethanesulfonic acid wets Teflon but water-monohydrate mixtures containing less than 60% of the monohydrate exhibit high contact angles with Teflon. Potential materials of construction for use in trifluoromethanesulfonic acid monohydrate and its water solutions were investigated. Corrosion tests, both stationary and under potential, showed that alloys such as ingot iron, chrome steel. Incoloy 825, tantalum-coated steel, and niobium offer considerable resistance to corrosion in the electrolyte. Certain composites such as pyrolytic graphite, silicon carbide, and boron carbide are chemically stable in the electrolyte.

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 43261

43262 **Acceleration of electrocatalytic reactions by pulsation of potential: oxidation of formic acid on Pt and Pt/Pb$sub ads$ electrodes.** Adzic, R.; Popov, K.I.; Pamic, M.A. (ICTM, Inst of Electrochem, Belgrade, Yugosl). *Electrochim. Acta;* **23**: No. 11, 1191-1196(Nov 1978).

Pulsating potential electrolysis has been applied to one typical electrocatalytic reaction ie, the oxidation of formic acid on platinum and platinum partially covered by lead atom electrodes. It is found that much higher average cds can be obtained with such regimes than in constant potential electrolysis. The effect can be of considerable interest for the application in electrochemical power sources. An analysis of the mechanism of effects of pulsating potentials is given. A calculated frequency dependence of the average current density is in agreement with experimental one for both electrodes.

ELECTROMECHANICAL CONVERTERS

REFER ALSO TO CITATION(S) 43582

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 42535, 42537, 43173, 43224, 43241

BUILDINGS

REFER ALSO TO CITATION(S) 42594, 43211, 43214, 43226

43263 (CONF-790362—1) **DOE Heat Pump Centered Integrated Community Energy Systems Project.** Calm, J.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From Heat pump technology information exchange meeting; Gaithersburg, MD, USA (7 Mar 1979).

The Heat Pump Centered Integrated Community Energy Systems (HP-ICES) Project is a multiphase undertaking seeking to demonstrate one or more operational HP-ICES by the end of 1983. The seven phases include System Development, Demonstration Design, Design Completion, HP-ICES Construction, Operation and Data Acquisition, HP-ICES Evaluation, and Upgraded Continuation. This project is sponsored by the Community Systems Branch, Office of Buildings and Community Systems, Assistant Secretary for Conservation and Solar Applicaions, U.S. Department of Energy (DOE). It is part of the Community Systems Program and is managed by the Energy and Environmental Systems Division of Argonne Natinal Laboratory.

43264 (LA—6995-MS(Rev.)) **Los Alamos Scientific Laboratory Building Cost Index.** Leach, C. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

Confidence in the President's 7% wage-price guidelines is eroding as inflation continues at a brisk rate. Escalating fuel costs and uncertain supplies cause industry's biggest doubts about the immediate future. Los Alamos Scientific Laboratory, after careful study of these and other factors, has determined to use a 10% construction cost escalation figure for FY 1979 and beyond. Los Alamos Scientific Laboratory Building Cost Index (LASLBCI) combines many types of reports and analyses. The computer program that was developed at LASL can analyze a much larger number of individual materials and equipment. Using a 1970 baseline, the costs were updated for each item in the data file, then the program plotted graphs for each material and equipment category and for each labor craft. The LASLBCI program, using weighted averages, generated the combined materials/equipment graph, the combined labor graph and the final LASLBCI projection. In addition, we referenced many economic forecasts encompassing both general economic reports and specific construction industry reports. We also conducted personal interviews with various regional and national suppliers, and we found that articles and charts from Engineering-News Record and various other private and government-authored reports corroborated these opinions. Specific labor rates were based on 1979 New Mexico State Labor contracts now in force. All these factors contributed to the LASLBCI.

43265 (NBSIR—79-1731) **Review of fire incidents, model building codes, and standards related to wood-burning appliances.** Peacock, R.D. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). May 1979. Contract EA-77-A-01-6010-047. 58p. Dep. NTIS, PC A04/MF A01.

As a part of the Department of Energy program to advance the technology for the utilization of fuel wood as an alternate energy source for applications ranging from single-family dwellings to apartment complexes and small industries, a review is presented of fire incidents and fire deaths attributable to wood-burning appliances. Initiated to establish accident patterns and to determine the risks involved with the use of wood-burning equipment, the survey represents a compilation of approximately 11,800 fire incidents including injuries and deaths associated with solid fuel burning appliances. In addition, a review of model building codes and of test methods currently used to test or certify wood-burning equipment is included to identify priorities for future research in wood-burning safety.

43266 **Temperature controlled instantaneous water heating apparatus.** Thorwaldson, W.S. US Patent 4,147,159. 3 Apr 1979. Filed date 18 Mar 1977. 8p.

The invention discloses an instantaneous, automatic gas water heater for a hot water system having a cold water supply conduit connected to a plurality of loosely wound small heat exchange tubes which, in turn are connected to a hot water outlet conduit having faucets. The heat exchange tubes are each of smaller internal diameter than the cold and hot water conduits but their total capacity is

substanially the same as said conduits. A gas burner is disposed beneath the heat exchange tubes to subject them to the flame of the burner. There is a cover over the heat exchange tubes which confines the heat from the burner about the tubes. The burner is supplied with gas by a gas supply conduit controlled by a normally closed solenoid valve including a gas control valve and a solenoid controlling the gas control valve. There is an electrical system for the solenoid valve and said electrical system includes a diaphragm controlled switch with the diaphragm sujected to water pressure in one of the conduits such as the cold water inlet conduit. There is also an adjustable temperature control thermostat mechanism subjected to and controlled in accordance with the temperature in the hot water conduit for controlling a second solenoid valve which controls gas to the burner.

43267 **Energy recovery system for refrigeration systems.** Ritchie, D.A. (to WeatherKing, Inc.). US Patent 4,141,222. 27 Feb 1979. Filed date 29 Mar 1978. 6p.

The invention discloses an energy recovery system for heating water with by-product heat from a refrigeration system wherein a heat exchanger within a refrigerant compressor hot gas conduit may selectively heat water within a storage tank. The flow of water through the storage tank and heat exchanger is controlled by a pump operating during operation of the compressor, preferably, only when the heat exchanger is sufficiently heated, and a temperature sensing diverting valve causes pumped water to by-pass the heat exchanger when the water temperature within the tank reaches a predetermined maximum value.

43268 **Fireplace fuel stove and grill device.** Fortier, G. US Patent 4,127,099. 28 Nov 1978. Filed date 25 May 1977. 4p.

A device is disclosed which selectively forms either a fireplace fuel stove or a cooking grill and which is characterized by its simple all metal knockdown construction to be readily transported for indoor or outdoor use. This fireplace and grill device includes a pair of opposite end members, a bottom, a front, and a rear plate extending between the opposite end members, hooks formed integral with these plates and removably connecting the latter to the end members, and grill plates removably engaging the upper portion of the rear plate and adjustable in height relative thereto. 1 clain, 4 figures.

43269 **Energy efficient lighting.** Clark, G.W. (GTE Sylvania, Inc., Danvers, MA). pp 313-317 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

The energy conservation opportunities possible with the proper design of, selection of the most efficient light sources for, and operation of lighting systems is discussed. It is concluded that, using available technology, lighting systems can be designed and operated so as to make an important contribution to energy conservation in the U.S.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 42546, 42693, 42704, 42709, 42856, 43179, 43215, 43220, 43238

43270 (BNL—25832) **Case study of the Brownell low energy requirement house (thermal storage analysis).** Jones, R.; Krajewski, R.; Dennehy, G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-C-02-0016. 15p. (CONF-790328—6). Dep. NTIS, PC A02/MF A01.

From Solar energy storage options workshop; San Antonio, TX, USA (18 Mar 1979).

An analysis is made of the thermal storage performance of an innovative residence built in the Adirondacks area of New York State by Adirondack Alternate Energy. A detailed case study report of this residence will be issued shortly by Brookhaven National Laboratory. Effective integral thermal storage provided by the exposed interior building structure, serves to keep interior temperature swings within acceptable limits. Additional remote thermal storage, is provided in the form of a large sand bed, with air ducts located below the basement floor slab. The building was instrumented and tested by BNL staff during January, February, and March of 1978, with technical assistance provided by the builder's staff. The thermal storage effects of the remote sand bed and the building materials available for thermal storage within the structure are quantified. The thermal storage performance of the exposed building materials was found to be quite effective. The existing sand bed, however, has a diurnal storage utilization factor of only 8%. Two hypothetical designs are shown which improve the storage bed utilization to 38% for a sand bed with an enhanced duct system and 61% for a ducted concrete slab. Other comparisons of these storage beds are also made, including a comparison with a rock bed storage system.

43271 (DOE/EIA—0102/50) **Residential sector energy forecasts, national level for 1978-electricity, natural gas, number two fuel oil and propane.** DonVito, P.; Walton, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1979. 23p. Dep. NTIS, PC A02/MF A01.

Methods and results of estimating the average 1978 price of fuels used in the residential sector are given. Average (as opposed to marginal) prices were requested and are given for electricity, natural gas, No. 2 fuel oil, and propane. The projected 1978 average fuel prices resulting from the analysis are: electricity, 4 cents/kWh; natural gas, 27.5 cents/therm; No. 2 fuel oil, 49.2 cents/gallon; and propane, 44.9 cents/gallon. Regional and seasonal variations are not discussed here. (MCW)

43272 (DOE/TIC—10650) **Distributional impact of energy policies: development and application of the Phase I comprehensive human resources data system. Task 8 final report.** King, J.A. (Mathematica Policy Research, Inc., Washington, DC (USA)). 30 Jun 1977. 208p. Dep. NTIS, PC A10/MF A01.

Comprehensive Human Resources Data System is a flexible policy analysis tool which may be linked with aggregate FEA energy models, such as PIES, to provide estimates of distributional impacts for scenarios consistent with those analyzed in these other models. The policy parameters available for manipulation, either singly or in combination, include energy taxes, technological improvements in auto and appliance efficiency, thermal standards for buildings, tax rebates and other redistributive mechanisms, energy prices, and some behavioral changes such as switching commuting modes or altering the thermostat setting. This report describes the Phase I Comprehensive Human Resources Data System and its application to simulate several different energy policy scenarios, specifically results simulated for 1974 and three 1985 scenarios.

43273 (HCP/B8681—01/3) **Technical institutional and economic analysis of alternative electric rate designs and related regulatory issues in support of DOE utility conservation programs and policy. Volume III. Economic analysis.** (ICF, Inc., Washington, DC (USA)). May 1979. Contract EM-77-C-01-8681. 334p. Dep. NTIS, PC A15/MF A01.

This report analyzes six electric utility innovative rate forms or rate designs: rates for solar back-up customers, rates for industrial cogeneration customers, flattened rates, residential demand-energy rates, rates for hydro-constrained utilities, and rates for load management. The analysis consists of three distinct, but interrelated components: development of cost-based ratemaking guidelines for each of the six rate-design areas; analysis of the impact of specific rate designs on electric-utility customers and their choices of technology (e.g., effects of rate designs on solar heating market penetration, etc.); and an analysis of the energy use and utility-side impacts of each of the six rate forms. The approach is unique in that it simultaneously determines the appropriate cost-based rate form or rate and the effects of implementing a particular rate. In addition, the impact of rate forms and customer choices of technology (e.g., solar, cogeneration) on load shapes, not just kWh output and peak demands is determined. A data base is developed for 6 "synthetic utilities". These utilities consist of aggregated data for the utilities in each of six states with widely varying customer-load and utility-system characteristics. The states are Texas, Wisconsin, Ohio, New Jersey, Oregon, and North Carolina.

43274 (HCP/M4228—01) **Status of thermal imaging technology as applied to conservation.** Shumaker, D.L.; Snow, F.J.; Barthle, R.C.; Culp, T.L.; Wood, J.T. (DCS Corp., Arlington, VA (USA)). Dec 1978. Contract EM-78-C-01-4228. 117p. Dep. NTIS, PC A06/MF A01.

One of the major goals indicated in the National Energy Plan is to bring 90% of existing American homes and all new buildings up to minimum energy efficiency standards by 1985. While such standards are as yet undefined, it is nevertheless essential that all buildings be adequately insulated. The ability to determine the effectiveness of existing insulation, or to pinpoint areas where existing insulation is either totally lacking or insufficient in quantity, is an implicit requirement of this goal. Thermal imaging systems offer the potential for being a significant tool for making such insulation measurements because of features which include nondestructive, non-contact and, in the case of aerial equipments, remote sensing over a substantial number of buildings at relatively low unit cost. The application of both imaging and non-imaging infrared equipments in the performance of thermal surveys is discussed, and a concise up-to-date status of the commercial availability and performance of infrared surveys for the detection of heat-loss/heat-gain in buildings is provided.

43275 **Wood burning stove.** Baker, A.L. US Patent 4,127,100. 28 Nov 1978. Filed date 30 Nov 1977. 8p.

A wood burning stove for providing heated air to a room or similar area is disclosed which includes a fire chamber, a hearth in the forward portion of the fire chamber, draft inlet means at the front of the fire chamber and a flue at the rear of the fire chamber. Between the hearth and the flue is an enclosed air chamber having front and rear walls; the air chamber communicates at its bottom with the ambient air and at its top with one or more air pipes which extend to the front of the stove and there open to the ambient air. A baffle plate is positioned between and spaced from the air chamber and the flue. Ambient air is heated by passing it through the air chamber and air pipes after they have been heated by hot gases rising from a fire burning on the hearth; the hot gases contact the air pipes and the front wall of the air chamber and, because their normal path of travel to the flue is altered by the baffle plate, contact the rear wall of the air chamber as well.

43276 Seasonal performance analysis of central furnace installations. Macriss, R.A.; Elkins, R.H.; Zawacki, T.S. Chicago, IL; Inst. of Gas Tech. (1978). 16p. (CONF-7810161—1).

From Conference on documentation and analysis of improvements in efficiency and performance of HVAC equipment and systems; West Lafayette, IN, USA (23 Oct 1978).

The seasonal performance of conventional residential gas and oil-fired central space-heating furnaces is greatly dependent upon furnace design but also on installation characteristics and overall system operation. As a result of extensive laboratory and field testing, a novel method of estimating the seasonal performance of such systems has been stipulated, field-verified, and used to project the seasonal performance of improved efficiency furnaces equipped with one or more of several design options. The SPACe-FI (for Seasonal Performance Analysis of Central Furnace Installations) model and method is a simple, improved version of ASHRAE's modified degree-day procedure and is based on fundamental considerations rather than empirical factors to account for the effect of climate and furnace oversizing on seasonal energy consumption. Basic inputs to the model and method include a model of flow up the chimney, the contribution of furnace operation to house infiltration, the partload efficiency of the furnace under prescribed conditions, a method of estimating the balance-point temperature of the structure, etc. Both flue-loss and heat-gain based part-load efficiencies of the furnace are used, as appropriate, especially with regard to estimating the seasonal consumption of a conventional furnace equipped with design options for improved performance. For rating conventional furnaces, and most of the recently proposed improved furnace versions to meet proposed efficiency targets, the SPACE-FI method requires only an ANSI-type measurement of steady-state efficiency.

43277 Study of the feasibility of energy-distributing companies to finance home and business insulation to the Govenor and the General Assembly of Virginia. Richmond, VA; Commonwealth of Virginia (1978). 63p. (NP—23773).

The State Corporation Commission conducted a study of the feasibility of energy distribution companies financing the insulation of homes and businesses. Results show that financing of insulation in homes and businesses by energy distribution companies is feasible; two companies provide such financing in Virginia and at least 13 companies operate programs in other states. This study finds that adequate insulation financing is available through existing conventional finance sources. An analysis of cost data provides evidence that energy distribution companies are not able to lend funds for insulation at lower cost than conventional finance sources. Therefore, there is no compelling reason to rely on energy distribution company insulation finance programs as a means of improving the level of insulation in homes and businesses in Virginia. This study does not question the potential benefit resulting from insulation as a means of energy conservation. It assumes benefits are sufficient to justify the installation of more insulation. This study addresses the desirability and need of having energy distribution companies engage in the financing of such insulation.

43278 Technical assistance in energy conservation. Gregoire, R.G. (Center for the Environment and Man, Inc., Hartford, CT). pp 319-324 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

Working curves are presented to be used in conjunction with client supplied information to determine potential fuel savings from several major energy conservation applications. The main applications investigated are adding storm and insulating windows and doors as well as insulating the attic and exterior walls.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 43286

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

43279 (ANL/CNSV-TM—1) **Case history study of cogeneration facility at Southeast Missouri State University, Cape Girardeau, Missouri.** (McClure (Charles J.R.) and Associates, Inc., St. Louis, MO (USA)). 1 Sep 1977. Contract W-31-109-ENG-38. 53p. Dep. NTIS, PC A04/MF A01.

The Southeast Missouri State University total energy plant, its fuel, control, production, operation, and maintenance are examined. A financial analysis looks at comparative operating costs for central heating (case 1), stand along (case 2), and cogeneration (case 3). Finally an evaluation of the performance of the plant indicates continuation of operation with some modifications.

43280 (DOE/TIC—10646) **Public schools energy conservation measures. Report No. 1: Scott Elementary School, Warwick, Rhode Island.** (American Association of School Administrators, Arlington, VA). 24 Jan 1977. 43p. Dep. NTIS, PC A03/MF A01.

A thorough engineering analysis was made of the energy consumption in the Scott Elementary School in Warwick, Rhode Island, and opportunities for conserving energy in the operation of the building were identified. Scott School is representative of a 1960's single level pod or modified open space school located in a 6,000 to 9,000 degree-day climate. The cost of the recommended conservation measures was estimated at $45,800 with a payback period of 7 years. (LCL)

43281 (DOE/TIC—10736) **Public schools energy conservation measures. Report No. 2: Central Elementary School, Glen Rock, New Jersey.** (American Association of School Administrators, Arlington, VA). 24 Jan 1977. 47p. Dep. NTIS, PC A03/MF A01.

A thorough engineering analysis was made of the energy consumption in the Central Elementary School in Glen Rock, New Jersey, and opportunities for conserving energy in the operation of the building were identified. Central School is representative of a 1920's building with a pre-World War II addition of similar construction and a 1950's addition located in a 3000 to 6000 degree-day climate. The cost of recommended conservation measures was estimated as $39,550 with a payback period of 6 years. (LCL)

43282 (DOE/TIC—10740) **Public schools energy conservation measures. Report No. 5: Fairmoor Elementary School, Columbus, Ohio.** (American Association of School Administrators, Arlington, VA). 24 Jan 1977. 52p. Dep. NTIS, PC A04/MF A01.

A thorough engineering analysis was made of the energy consumption in the Fairmoor Elementary School in Columbus, Ohio, and opportunities for conserving energy in the operation of the building were identified. Fairmoor School is representative of a late 1940's multistory building with a single story 1950's addition located in a 3,000 to 6,000 degree-day climate. The cost of the recommended conservation measures was estimated at $25,700 with a payback period of less than 3 years. (LCL)

43283 (DOE/TIC—10741) **Public schools energy conservation measures. Report No. 3: Everitt Elementary School, Langhorne, Pennsylvania.** (American Association of School Administrators, Arlington, VA). 24 Jan 1977. 41p. Dep. NTIS, PC A03/MF A01.

A thorough engineering analysis was made of the energy consumption in the Samuel Everitt Elementary School in Langhorne, Pennsylvania, and opportunities for conserving energy in the operation of the building were identified. The Samuel Everitt School is representative of a 1950's building with two additions located in a 3,000 to 6,000 degree-day climate. The cost of the recommended conservation measures was estimated at $21,200 with a payback period of 7 years. (LCL)

43284 (NMEI—76-166) **Instrumentation and demonstration of a boiler economizer coil for heating plant heat recovery.** Schuster, L.J.; Williamson, M.J. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Oct 1978. 3p. Univ. of New Mexico, Albuquerque.

The University of New Mexico is installing boiler economizer coils on 2 of their 100,000 lb/hr gas-fired boilers used to provide steam for both heating and cooling the campus buildings. In order to evaluate the economic justification of this heat recovery equipment, redundant instrumentation systems are being installed on one boiler. These systems and plans for using the performance data derived from the measurements are briefly described. (LCL)

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 43277

43285 (AED-CONF—77-405-007) **Analyzing the energy demand of air conditioning and ventilation systems in department stores.** Schramek, E.R. (Karstadt A.G., Essen (Germany, F.R.)). 1977. 35p. (In German). (CONF-7710159—4). Dep. NTIS (US Sales Only), PC A03/MF A01.

From DKV annual meeting; Hannover, F.R. Germany (6 Oct 1977).

The energy demand for air conditioning and ventilation systems in department stores is analyzed in detail. In view of the present cost of heating fuel oil, electric power, and gas, detailed knowledge on energy consumption has become an important cost factor. Oil has considerable advantages over electric power and gas.

43286 (COO—4556-2) **Analysis of battery storage for commercial buildings. Phase 1 final report.** (TRW Energy Systems Group, Redondo Beach, CA (USA)). Sep 1978. Contract EC-77-C-02-4556. 107p. Dep. NTIS, PC A06/MF A01.

The application of battery storage to load leveling by the utility user represents a new concept in energy management. TRW Energy Management Systems Division has studied the possibility of combining an energy management computer/control system with a lead-acid/power processor system and explored the feasibility of demonstrating power management at a government facility. Candidate sites in the Washington, D.C. metropolitan area were evaluated by analyzing demand curves for electricity. One site, the Department of the Treasury's Bureau of Printing and Engraving is recommended as the best of the sites evaluated. Analysis using estimated production system costs of $130/kW for power processors and $80/kWh for lead acid batteries indicates a payback of nine years. However, if the Department of Energy's cost goals for batteries and converters are achieved, a payback in less than four years is possible. Furthermore, coupling battery energy storage with conventional computer based energy management is projected to offer substantial reductions in utility bills. Payback from a production system in less than two years is predicted. System design is based on using present day technolgy where possible for the system components. Capacity for the system has been set at 1.1 MWh with a peak load capability of 600 kW. Preliminary specifications are supplied. Facility modification and system layout are presented, giving alternate placements for the batteries. Floor loading and system safety are two critical design parameters.

TRANSPORTATION

REFER ALSO TO CITATION(S) 43188, 43206

43287 (DOE/EIA—0102/47) **Capital requirements for the transportation of energy materials based on PIES scenario estimates. Analysis Memorandum AM/EI/79/19.** Kendrick, M.J. (TERA, Inc., Arlington, VA (USA)). Jan 1979. 233p. Dep. NTIS, PC A11/MF A01.

Capital requirements to transport coal, crude oil, petroleum products, and natural gas in the year 1985 are estimated. These requirements are based on PIES Scenarios A, C, and E which represent three alternatives for the future. The approach used to estimate requirements consists of the following three elements: formulate interregional origin-destination energy-flow matrices for crude oil, petroleum products, natural gas, and coal by using appropriate PIES scenario runs, solution files, and other relevant information; compare the above flows with data on existing facilities and networks to determine major interregional shifts and the potential need for capacity expansion in the transportation of energy on the basis of prevailing modal splits; and specify, analyze, and estimate the requirements and the capital costs of major capacity improvements and increases in transportation capacity under alternative assumptions. These estimates take into account the anticipated lead times associated with different types of projects and equipment needs. The total investment requirements for the national energy transportation system to effectively serve the nation's energy needs in 1985 are estimated to be $29.6 to $31.5 billion in lower range, and $33.6 to $35.7 billion in the upper range.

AIR AND AEROSPACE

43288 (N—79-11406) **Automotive stirling engine development program. Quarterly technical progress report, Apr—Jun 1978.** (Ford Motor Co., Dearborn, MI (USA)). Jun 1978. Contract EC-77-C-02-4396. 96p. NTIS PC A05/MF A01.

The third quarter (April-June, 1978) effort of the Ford/DOE Automotive Stirling Engine Development Program is reported, specifically Task 1 of that effort, which is Fuel Economy Assessment. At the end of this quarter the total fourth generation fuel economy projection was 26.12 MPG (gasoline) with a confidence level of 44%. This represents an improvement of 66.4% over the baseline M-H fuel economy of 15.7 MPG. The confidence level for the original 20.6 MPG goal has been increased from 53% to 57%. Engine 3X17 has accumulated a total of 213 hours of variable speed running. A summary of the individual sub-tasks of Task 1 are given. The sub-tasks are grouped into two categories: Category 1 consists of those sub-tasks which are directly related to fuel economy and Category 2 consists of those sub-tasks which are not directly related to fuel economy but are an integral part of the Task 1 effort.

43289 **Dual cycle gas turbine engine system.** Moellmann, H.F. (to Avco Corp.). US Patent 4,147,024. 3 Apr 1979. Filed date 15 Sep 1977. 6p.

A dual cycle turbine system is described which includes a combination of two engines with different cycle pressure ratios. The two engines are cross connected by a common regenerator that enables low specific fuel consumption under partial load conditions.

RAILWAY

43290 (DOT/RSPD/DPB—50-78/7) **Energy intensity of intercity passenger rail. Final report.** Mittal, R.K. (Department of Transportation, Washington, DC (USA). Office of Univ. Research). Dec 1977. 296p. Dept. of Transportation, Washington, DC.

This research report deals with the Energy Intensity of Intercity Rail Passenger Systems. Included in the energy evaluation are the impacts of operating conditions (speed, load factor) and train consists. The report also documents an extensive list of data used for evaluation purposes. Impact of track on energy intensity is also documented. Several trains are simulated along the New York City-to-Buffalo Corridor. Increases in energy efficiency due to modernization of rolling stock and improvements of track and service conditions are also analyzed to insure equitable comparison among the competitive modes. The study concludes that: presently the energy-intensity figures are high because the load factor is low; there is a considerable potential for improving values by improving the attractiveness (reduced trip time) of the trains and also by using contemporary rolling stock. It is also concluded that presently, because of the poor track conditions, the maximum potential of the trains (in terms of speed, etc.) cannot be realized. Improved track conditions will enhance block speed which would results in increased rail patronage (consequently, higher load factor) and reduced energy intensity. Electric trains were also studied (along NYC to Washington, D.C.) and are quite favorable from an energy-intensity viewpoint. The study provides guidelines for energy conservation, will serve the railroad industry, and has a potential for nationwide application.

43291 (PB—287597) **Track systems and other related railroad topics. Transportation research record.** (Transportation Research Board, Washington, DC (USA)). 1977. 71p.

The 11 papers in this report deal with the following areas: effect of design parameters on track support systems; improvement in rail support; track structure systems; problems and needs in tie and fastener research; track-structure analysis: methodology and verification; track structure at facility for accelerated service testing; problems and needs in track structure design and analysis; use of floating-slab track bed for noise and vibration abatement; assistance of New York State Department of Transportation to railroad in solving soils and foundation problems; mechanical testing at facility for accelerated service testing; and solar-powered refrigeration system for railway refrigerator cars.

43292 (PB—287797) **Study of BART's consumption of land and property. land use and urban development project. Working paper report.** Dyett, M.V.; Castle, G.H. III. (Department of Housing and Urban Development, Washington, DC (USA)). May 1978. Contract DOT-OS-30176. 51p. NTIS PC A04/MF A01.

The paper documents BART's consumption of land and property in terms of the characteristics of business and people displaced, describes the relocation process, and examines development on surplus land BART acquired and subsequently sold. Study methods included statistical analysis of parcel data obtained from the BART Real Estate Department and the California Department of Transportation, a small survey of households and firms receiving relocation payments from BART, and key informant interviews with persons knowledgeable about BART's real estate activities. The paper closes with assessment of policy implications. (Color illustrations reproduced in black and white)

43293 (UCRL—50025-79-1, pp 18-23) **Electromagnetic cross-borehole survey helps determine geologic characteristics.** 30 Mar 1979.

In Electronics engineering department. Quarterly report No. 1, 1979.

LLL has developed and tested an underground imaging method for probing between boreholes and has applied the method to characterize a site for a future urban rapid-transit station - the Forest Glen/Georgia Avenue station in Washington, D.C. Using this technique, a subsurface region's transmission properties can be sampled by sending a continuous-wave electromagnetic signal between a transmitter and a receiver in different boreholes. From the network of sampled signals, which vary according to the electrical properties of the media through which they pass, one can mathematically determine, in fine detail, the region's geologic properties.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 43272

43294 Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977). 205p. (CONF-7710194—).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

A separate abstract was prepared for each individual paper. (TFD)

43295 (PB—286651) Evaluation of restorative maintenance on 1975 and 1976 light-duty vehicles in Detroit, Michigan. Gafford, R.; Carlson, R. (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). May 1977. Contract EPA-68-03-2379. 233p. NTIS PC A11/MF A01.

A study of exhaust emissions from 100 consumer-owned 1975-1976 model-year light-duty vehicles equally represented by the big three manufacturers was performed by Olson Laboratories, Inc., in Livonia, Michigan to determine the relationship of emissions to the maintenance condition of the vehicles. All vehicles were tested using the 1975 Federal Test Procedure. Additional emission tests were conducted including Highway Fuel Economy Tests and several short-cycle tests. Each vehicle was tested initially in the as-received condition. Various stages of restorative maintenance and retesting were then performed in an attempt to bring vehicles which failed the emission standards into compliance. Selected vehicles were also subjected to a series of specified maladjustments or disablements in order to evaluate the individual and combined effects of these conditions on emissions and fuel economy.

43296 Power consumption of tires related to how they are used. Klamp, W.K. pp 5-11 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

The fuel needed to overcome the rolling resistance of tires amounts to 5% of the nation's fuel. A significant portion of this fuel can be saved by controlling the manner in which the tire is used. One important factor is the tire's inflation pressure. Steps taken to increase and maintain inflation pressure would lead to substantial fuel savings.

43297 Comparison of radial and non-radial tire construction with respect to rolling resistance and vehicle fuel economy. Campbell, K.L. pp 13-19 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

The test procedures used and the results of tests comparing radial passenger car and truck tires with non-radial tires for rolling resistance and fuel economy are presented. The tires used were new and of the type normally provided as original equipment. Radial passenger car tires had an average of 21% less rolling resistance and an average of 10% improved fuel economy at a constant speed of 50 mph compared to belted bias tires over a wide range of sizes. Radial truck tires exhibited 6% improved fuel economy compared to bias ply tires when tested under open highway driving conditions.

43298 What's needed to improve steady state test methods. Stiebel, A. pp 39-48 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

An overview of present day power consumption measuring systems is presented. It is shown that discrepancies encountered in measuring power consumption are not caused by the instrumentation, but rather by testing conditions which are not fully understood. A number of problem areas are outlined and discussed. A new method for power consumption measurements is presented which reduces test-time from hours to minutes. Recommendations are made to investigate the possibility of establishing a common base line to which tire loss values should be reduced.

43299 Variations in tire rolling resistance: a real world information need. Thompson, G.D.; Torres, M. pp 49-63 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

The tire rolling resistance data obtained in a recent road load project are analyzed. Statistically significant variations were observed by tire type, tire manufacturer, and tire size. The difference between the means of the rolling resistance coefficients for radial versus bias ply tires was approximately 24%. The observed variations among manufacturers were surprisingly large. The range of the variations among the manufacturers, within the class of radial or bias tires, was greater than the difference between the overall means of these tire types. In the case of radial tires, the range of variations by tire size was somewhat smaller than the difference between the tire type means, while in the case of bias ply tires, the range of the variations by tire size was about the same as this difference between the tire types.

43300 Laboratory measurements of tire rolling resistance under simulated driving cycles. Gusakov, I. (Calspan Corp., Buffalo, NY). pp 65-71 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Recommendations are made for research and development activities that will lead to laboratory tire rolling resistance measurements under realistic operating conditions. Simulation of a driving cycle is advocated to augment the currently accepted practice of conducting measurements under equilibrium conditions. Energy consumed by the tire during a driving cycle can then be used as a criteria to evaluate and compare tire samples with respect to their rolling resistance characteristics.

43301 Tire rolling resistance via viscoelastic analysis of the components. Prevorsek, D.C.; Kwon, Y.D.; Sharma, R.K. pp 75-86 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

A method is described to establish the relationship between the tire rolling resistance and total heat loss from the tire. The heat loss is determined from cross-sectional temperature profiles in the tire which are calculated by solving the energy transfer equations containing the heat generation terms. The da input required in this solution comprises: (1) tire construction variables such as tire geometry, number of plies, ply construction; cord characteristics, belt design, etc.; (2) dynamic viscoelastic properties of components (cord, rubber, etc.) as function of strain amplitude, frequency and temperature; (3) material properties appearing in energy transfer equations such as density, heat capability and thermal conductivity; (4) heat transfer coefficients; and (5) five to six tire temperatures during rolling at positions which enable the determination of complete temperature profile. Rolling resistance of several types of tires is measured and heat loss estimated by the above procedure. In addition, the effect of tire testing conditions (i.e., speed and load on tire) on these two tire performance characteristics was investigated. In all cases, good correlation between rolling resistance and heat loss was found.

43302 Numerical simulation of rolling tires. Padovan, J. (Univ. of Akron, OH). pp 87-94 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

An overview is presented of the basic requirements which an analytical/numerical (finite element) simulation of the power dissipation-rolling resistance problem of tires must satisfy. In conjunction with the overview, a steady state model is developed. The results of several numerical examples produced with the model are also presented.

43303 Analytical method for tire power loss calculations. Tielking, J.T.; Schapery, R.A. (Texas A and M Univ., College Station). pp 95-102 of Tire rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

An analytical method for calculating the influence of tire design parameters on steady-state tire power loss is presented. The analysis is based on the assumptions that tire structural response is linearly viscoelastic with respect to contact loads, and tire material exhibits a low loss tangent. Linearity with respect to inflation pressure and centrifugal forces is not assumed. These assumptions permit viscoelastic power loss to be calculated from load transfer functions derived from solutions for the elastic response of the tire. The loss components of the moduli of both rubber and cord are included in predicting power loss. The analytical method is not tied to any particular tire model. Power loss calculations made with a continuum tire model are presented in order to illustrate the method, and the utilization of a finite element tire model is discussed.

43304 Applications of tire thermography to rolling resistance. Trivisonno, N.M. pp 103-109 of Tire rolling losses and fuel econo-

my: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

A nonsteady-state finite difference thermal analysis procedure has been developed which makes it possible to calculate internal temperatures, heat generation rates in each part of a rolling tire and total power loss from infrared surface temperature measurements made on the tire. The procedure can also be reversed to calculate internal temperatures, heat generation rates in each part of the tire and nonsteady-state power loss for any combination and sequence of load, speed, inflation pressure, ambient temperatures and time once the appropriate experiments have been run to determine heat generation rates as functions of these variables.

43305 Geometric effects on the rolling resistance of pneumatic tires. Clark, S.K. pp 111-119 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Although it is not fully understood at the present time, it is clear that there are geometric influences on the rolling resistance of a pneumatic tire which can contribute significantly to the overall problem of a reduction of fuel consumption on both passenger car and commercial vehicles. It is recommended that this phenomena be clearly defined by further analytical studies so that the impact of tire geometry on fuel economy may be taken into account when considering possible directions for future commercial and passenger vehicle design.

43306 Pavement and tire rolling resistance coefficients for vehicle energy prediction. Phelps, R.E.; Mingle, J.G. (Oregon State Univ., Corvallis). pp 123-132 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

The individual tractive resistance forces, which must be overcome to provide the vehicle with motion at the desired speed, must be examined and evaluated to model the performance of trucks mathematically. Many investigators have published work on this subject, but a comparison of their results show rather wide variations in some places. Further, tire and road materials and vehicle mechanics have changed over the years and some of the equation coefficients in print need to be evaluated in the light of present practice.

43307 Determination of effective rolling resistance by coastdown experiments on smooth and rough roads. Korst, H.H.; Funfsinn, M.A. (Univ. of Illinois, Urbana). pp 133-141 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Coastdown experiments on rough roads, when compared with coastdown records for the same vehicle on a smooth level road, allow the determination of road resistance increase due to road roughness. Laboratory tests are required to establish the velocity dependency of the tire rolling resistance for smooth surfaces. With this information available, the method of parameter identification by optimization can be used effectively to extract reasonably accurate results for drag coefficients and rolling resistance for smooth and rough roads. Data acquisition and data processing procedures - which are strongly computer oriented - are described. A brief account is given of computer simulation results of vehicle-obstacle encounters by means of a four-degree of freedom energy-dissipative dynamic model.

43308 Influence of road surface texture on tire rolling resistance. DeRaad, L.W. pp 143-149 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Tire rolling resistance losses can be significantly influenced by road surface texture. Data obtained from laboratory tire dynamometer tests and outdoor tests conducted on various paved public type roads indicate that tire rolling resistance losses increase as road surface texture increases. Some tires are more sensitive to surface texture than others, and relative tire comparisons may depend upon the test surface used. Developments in road surface texture may be an additional approach to the question of tire rolling resistance. Other tire performance areas like noise and traction are also affected by surface texture; therefore, future road surface developments should be based on a consideration of the interaction between surface texture and tire performance.

43309 Wheel/vehicle energy losses through road contact. Hodges, H.C.; Hodges, H.C. Jr. pp 151-154 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

The rolling resistance of a tire is not necessarily significant in fuel saving. The only significant energy which a tire can waste is slip energy, defined as the product of the total horizontal force acting at the interface and the total relative slip distance induced by that force. In order to quantify the slip energy disposition an instrument system, which measures the triaxial forces and the triaxial velocities acting on each wheel simultaneously, has been designed and is currently in operation at the Nevada Automotive Test Center.

43310 Effect of tread polymer variations on radial tire rolling resistance. Hunt, J.D.; Walter, J.D.; Hall, G.L. pp 161-168 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Steel belted radial passenger tires featuring various tread polymers were evaluated for rolling resistance characteristics. The lowest rolling losses were measured in natural rubber treads; the highest in butyl treads. Excellent correlation was obtained between the damping coefficient (or loss modulus) of the tread rubbers as measured by forced vibration testing and tire rolling resistance.

43311 Effect of passenger tire reinforcing materials on rolling resistance. Vorachek, J.J.; Dill, R.J.; Montag, R.J. pp 169-178 of Rolling losses and fuel economy: an R and D planning workshop. Troy, MI; Society of Automotive Engineers, Inc. (1977).

From Tire rolling losses and fuel economy a R and D planning workshop; Cambridge, MA, USA (18 Oct 1977).

Emphasis has been placed upon determining the contribution of carcass and belt reinforcement materials to rolling resistance, rather than balanced tire designs. HR78-15 Custom Polysteel Radial designs were modified to include rayon, nylon, polyester, fiberglass, and aramid carcasses. In addition, fiberglass, aramid, and two types of steel cords were used in the belts. Rolling resistance data were generated with coast down and constant speed wheel methods. Although many of the reinforcements did not show significant differences, several did. Major reduction was observed in rolling resistance for both aramid carcasses and aramid belts. Rayon carcasses were characterized by higher rolling resistance. Carcass and belt weights have an important effect.

INDUSTRY AND AGRICULTURE

ENERGY SOURCES

43312 (AD-A—059993) **Flame - forestry lands allocated for managing energy. feasibility study. Final report jun-aug 78.** Lowther, J.D. (Civil and Environmental Engineering Development Office, Tyndall AFB, FL (USA). Detachment 1 (ADTC)). Sep 1978. 28p. NTIS PC A03/MF A01.

The study evaluates the feasibility of using wood grown on USAF installations as fuel to supply the heating energy requirements of the installations, replacing conventional fossil fuels currently being used. Arnold Engineering Development Center, Tennessee; Barksdale AFB, Louisiana; Eglin AFB, Florida; and Tyndall AFB, Florida have the potential for supplying significant portions of their heating energy requirements with non-merchantable timber grown on the installations. Avon Park Air Force Range, Florida has the potential to supply its own small heating energy requirements plus those of MacDill AFB, which is 75 miles away. Arnold Engineering Development Center presently has a central plant heating system. The system can be converted to a wood-burning system by altering existing boilers or replacing them with boilers having wood-firing capability. The remaining installations do not have central plant heating systems, but use small natural gas and oil-fired heating units in individual buildings. Conversion of these installations to burn wood would require construction of a wood-fired central system or systems. An alternate method of converting these installations is through the use of a pyrolysis unit to convert wood to fuel gas and fuel oil which can be burned in existing heating units. The latter alternative cannot be implemented until a large scale, continuously operated pyrolysis unit is developed.

43313 (ANL/EES-TM—42) **Energy requirements of the U.S. pulp and paper industry.** Cosman, C.M. (Mineral Economics Consultants, Inc., Swarthmore, PA (USA)). Jan 1979. Contract W-31-109-ENG-38. 119p. Dep. NTIS, PC A06/MF A01.

According to the American Paper Institute, the paper industry is the fifth largest consumer of purchased energy in the U.S. and the largest consumer of fuel oil. Almost one-half of its total energy

consumption comes from the industry's own process wasts: spent pulping liquors, bark, and hogged wood. In 1976 non-fossil fuels provided 44.6% of the total Btu consumption, up from 41.1% in 1972 and 42.6% in 1975. (Self-generated hydro power and other electricity produced from fossil fuel supplied another 1.5% of total needs in 1972 and 2.1% in 1975.) The industry has established a mechanism for self-policing by submitting periodic reports on its energy consumption to the API. The target set by the industry is a 20% saving of purchased energy by 1980. So far a reduction of about 15% has been achieved, making adjustments for add-ons required because of environmental regulations and other changes vs the base year of 1972.

43314 (DOE/TIC—10624) **Development and establishment of an energy efficiency improvement target for SIC 32: stone, clay, and glass products. Final report.** Schorr, J.R.; Snyder, M.J.; Barr, H.W.; Duckworth, W.H.; Hooie, D.T.; Lennon, J.W.; Spinosa, E.D.; White, A.M. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 10 Mar 1977. 44p. Dep. NTIS, PC A03/MF A01.

In accordance with Section 374 of the Energy Policy and Conservation Act (EPCA), the Federal Energy Administration (FEA) proposed industrial energy efficiency improvement targets for the ten most energy-consumptive manufacturing industries in the U.S. Following public hearings and review of the written comments which were submitted to FEA, the final target for Stone, Clay, and Glass Products (Standard Industrial Classification 32) has been developed and is described. The draft target for energy efficiency improvement in SIC 32 which was determined to be technically and economically feasible was 17% for 1980 energy consumption as compared with 1972 energy consumption. The target resulted from a weighted aggregation of the energy reductions expected to be achieved by the individual components which make up SIC 32. The values for the individual components ranged from a low of 0.46 x 10^{12} Btu to a high of 108.24 x 10^{12} Btu. The total for SIC 32 was 290.14 x 10^{12} Btu. The SIC 32 target was calculated by dividing 290.14 x 10^{12} Btu by the 1980 energy consumption at 1972 efficiencies (1752.60 x 10^{12} Btu) and rounding off to the nearest integer.

43315 (TID—28963) **Wood fuel fired electric power generating plants. Summary and report, Volume 1.** Pingrey, D.W.; Waggoner, N.E. (Nor'West-Pacific Corp., Seattle, WA (USA)). 1978. Contract EY-77-X-06-0626. 38p. Dep. NTIS, PC A03/MF A01.

A questionnaire study was made of the forest projects, pulp and paper and other industries that burn wood for fuel to produce electricity from steam. In the fall of 1977, inquiries were sent out to industry and government to locate wood-burning electrical power production facilities. A study of the information obtained from the questionnaires indicated that: electrical generating facilities were being operated continuously in the pulp and paper and other industries, but only about one-half of the forest products industry mills did so; fossil fuel comprised about 54.5% of fuels used for electric generation by the pulp and paper industry but only 1 or 2% of the fuels used by the forest products and other industries who burned woody residues; of the 39 pulp and paper mills reporting only 5 were not co-generating as opposed to the forest products industry where 20 out of the 27 responding mills were not; all mills used their wood wastes and about one-half of the mills purchased waste wood residues from others at an average price of about $6.00 per ton (wet); questionnaires were returned locating 82.6 MW of electrical production capability from 24 forest products industry mills; questionnaires were returned locating 1010.6 MW of electrical power production capability from 36 pulp and paper mills; and the electrical powerproduction capability of the pulp and paper industry was estimated to be about 3600 MW and the same capability for the forest products industry was estimated to be 800 MW. The study indicates that while the pulp and paper industry was using and purchasing wood residues to reduce energy demands, the forest products industry generally was not using its available wastes and generating capacity to produce electricity. The production and sale of electrical power produced from wood residues at the rates being offered by the electric utilities, were too low to stimulate interest or show a profit.

MATERIALS

REFER ALSO TO CITATION(S) 43347

43316 (BNL—50955) **Polyketones and polysulfones for conservation in the ethylene polymer industry. Progress report No. 2, April—September 1978.** Johnson, R. (Brookhaven National Lab., Upton, NY (USA)). Dec 1978. Contract EY-76-C-02-0016. 44p. Dep. NTIS, PC A03/MF A01.

A program is underway to investigate the substitution and introduction of CO and SO_2 into high molecular weight polymers of ethylene for the purpose of conserving ethylene feedstock for the polymer market. Et—CO polyketone copolymers, Et—SO_2 polysulfone copolymers and Et—CO—SO_2-terpolymers have been produced by ^{60}Co gamma radiation and by electron beam machine radiation. This is the first time that E-beam radiation has been used to produce these copolymers in high pressure systems. The yield for the 1:1 Et—CO polyketone copolymers appears to be square root dependent on the intensity. The electron machine radiation yields appear to be lower (G = 10^2 to 10^3) than that obtained with ^{60}Co gamma radiation (G = 10^3 to 10^4) or with bremstrahlung radiation produced by the electron beam interacting with the pressure vessel. The lower yields may be due to the high radiation intensity of the electron beam. The yield of Et—SO_2 polysulfone copolymer appears to be independent of radiation intensity and appears to be very high (G = 10^4 to 10^5) either with ^{60}Co or electron machine radiation. A strong post-irradiation polymerization effect is observed in the Et—SO_2 copolymer system. This is the first time an Et—CO—SO_2 copolymer has been reported especially with a content as low as 36 mole % ethylene and 64 mole % of combined CO and SO_2. The Et copolymers (1 to 1 Et—CO and 1 to 1 Et—SO_2) appear to be stable up to temperatures in the order of 275 to 300°C and the Et—CO copolymer has shown good tensile strengths. Much further characterization and formulation of the copolymer and terpolymer systems are needed to determine their market value.

43317 (BNL—50984) **Polyketones and polysulfones for conservation in the ethylene polymer industry. Progress report No. 3, October—December 1978.** Johnson, R. (Brookhaven National Lab., Upton, NY (USA)). Dec 1978. Contract EY-76-C-02-0016. 19p. Dep. NTIS, PC A02/MF A01.

The objectives of this program is to substitute relatively large quantities of CO into ethylene copolymers forming polyketones and determine their market value as a low cost and energy conservative polymer. Preliminary studies have also been performed with Et—SO_2 mixtures forming polysulfone copolymers. The work accomplished during this period is summarized below. Pound quantities of Et—CO copolymers have been produced at pressures of 680 atm with G-values range from 1000 to 3600. Oxygen acts as an inhibitor to polymerization. Tenneco Chemicals, Inc. is in the process of evaluating the properties of the copolymer. Et—CO gas copolymerized at low pressures in the order of 5 atm indicated low yields and produced a low molecular weight waxy material. Et—SO_2 copolymer can be produced at low pressure (< 5 atm) in the gas phase by means of ^{60}Co gamma radiation with chemical and physical properties that appear to be comparable to that of the copolymer made at higher pressure (> 50 atm). The yield in terms of G-values are high ranging to 10,000. Oxygen which initially acts as an inhibitor on subsequent radiation may act as a catalyst enhancing the rate of polymerization. Et—SO_2 can be produced by thermocatalytic means, however, the most stable 1:1 Et—SO_2 copolymer was not produced. The properties of the copolymer have yet to be measured to determine the relative value of the thermal versus the radiation treatment.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 42599, 43316, 43317, 43502

43318 (ANL/OEPM—78-2) **Energy and cost calculations. I. Optimization of electrochemical processes to achieve minimum product cost and the impact on energy consumption.** Keller, R. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 49p. Dep. NTIS, PC A03/MF A01.

In industrial electrochemical processes, the cost resulting from energy consumption and other costs are optimized by operating at an optimum current density. In this report, the interrelationships between process operating conditions, product cost, and energy consumption are studied by means of model calculations. The effect of changes in energy price and of process improvements has been estimated; the energy consumption of new, undeveloped processes has been predicted; and electrolytic processes to produce aluminum, chlor—alkali electrolysis, and copper refining have been examined.

43319 (CONF-7808102—, pp 6p, Paper 10) **Fuel conservation using balanced burner control and low-excess air firing.** Varga, G.M. Jr.; Bartok, W. (Exxon Research and Engineering Co., Linden, NJ). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

The application of low-excess-air (LEA) firing to industrial combustion equipment holds the potential for both reducing fuel consumption and the combustion-associated pollution emissions of NO/sub x/ and SO_3. The utilization of LEA firing by the U.S. industrial community in the past has been limited because of the availability of cheap fuel, possible problems associated with unbalanced burners, flame stability and high labor input. Recently, advanced instrumentation has become available to automate LEA firing in industrial and other combustion equipment. The instrumentation is called the Spectral Fuel Conservation System (SFCS) and is manufactured by Environmental Data Corporation. The SFCS is

designed to balance burners in multiburner installations thereby making feasible the reduction of excess air to lower workable levels than would be practical with unbalanced burners. The lower the practical level of excess air the greater the fuel savings which can result. The U.S. Department of Energy has recognized the potential value of this type of system and is now sponsoring an evaluation, test, and demonstration of the system. A multi-element test program was formulated to determine the efficacy of the SFCS and its applicability to the industrial environment. The results of this test may show that the industrial community will have available for its use instrumentatin for simultaneously reducing fuel consumption and pollution emissions.

43320 (CONF-7808102—, pp 43p, Paper 11) **Electric heat pumps for grain drying.** Hogan, M.R.; Doering, O.C.; Foster, G.H.; Okos, M.R. (Purdue Univ., Lafayette, IN). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Tight supplies of the convenience fossil fuels and the urgent need for energy conservation have prompted investigations into efficient, reliable, alternate heat sources for grain drying. The heat pump is an especially viable alternative source because it delivers more energy as heat than it consumes. In addition, it utilizes one of the most reliable energy forms available to the farmer - electricity. The energy requirements of agriculture with respect to grain drying is discussed. Current drying methods as well as potential heat-pump systems are reviewed. Recent development work and test results from a prototype heat-pump dryer are presented, and a review of current heat-pump drying research and development is given.

43321 (LBL—9139) **Inventory of energy conservation potential in California: the cement industry.** Kuhn, P.; Hudson, K.; Blumstein, C.; York, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 46p. Dep. NTIS, PC A03/MF A01.

The purpose of the inventory is to assist the California Energy Commission in establishing a system for organizing and analyzing information on energy conservation opportunities. In 1976, the California cement industry consumed nearly 9% of the fuel and 3% of the electricity purchased by all California manufacturers. Some energy-saving opportunities discussed are: measures for exiting plants, cogeneration, and new kiln and grinding systems. Other areas covered are: environmental concerns, fuel switching, first and second law considerations, international comparisons of energy use in cement manufacture, and institutional factors. Information included in technical notes includes estimate of effect of planned installations on post-1981 fuel consumption and electricity consumption and estimate of cogeneration's potential for reducing purchased electricity requirements. (MCW)

43322 (PB—287374) **Beef feedlot design and management in Michigan. Research report.** (Michigan State Univ., East Lansing (USA). Agricultural Experiment Station). Feb 1976. 34p. NTIS PC A03/MF A01.

The major direction of this study was to analyze the technical design and functional management of beef feedlots relative to possible impacts on environmental quality concerns and energy usage and monetary costs incurred by producers. Three specific tasks were undertaken including: (1) The evaluation of the chemical composition of cattle manure as affected by the housing system and the nitrate and salt status of cropland to which manure is applied; (2) The estimation of capital outlays, annual costs and energy usage associated with alternative technology-output levels for fed beef and; (3) The appraisal of the economic impacts resulting from the possible imposition of selected pollution control measures. The data and results from this research pertain specifically to southern Michigan, but they are also applicable to larger areas of the Corn Belt.

43323 (PB—287535) **Better water management and conservation possible--but constraints need to be overcome.** (General Accounting Office, Washington, DC (USA). Community and Economic Development Div.). 31 Oct 1978. 37p. NTIS PC A03/MF A01.

This report is the fifth of a series concerning the Bureau of Reclamation's efforts to promote better water management and conservation. It discusses ways to overcome constraints to achieving irrigation efficiencies and should help implement the President's water policy initiatives announced in June 1978.

43324 **Method for controlling the curing of field-harvested grains with minimum energy consumption.** Steffen, S.L. US Patent 4,148,147. 10 Apr 1979. Filed date 28 Oct 1977. 14p.

A process for optimum usage of energy in curing of grain in a bin using free energy of atmospheric air is disclosed. Optimum utilization of energy in the operation of ventilation fans and dehumidification of atmospheric air without waste of energy is achieved by operating fans and infrared emitters only when required as dictated by the measured temperature differential between the air entering and the air exhausting from the bin. As physiological activity and metabolic processes of the freshly harvested seeds decrease, as indicated by exchanges of heat and moisture between the seeds and the environment, the energy needed to maintain a biologically safe environment also decreases. Energy is considered to be wasted when it forcibly causes the seed to release moisture at a rate more rapid than would occur under average atmospheric conditions; further, required levels of ventilation and levels of dehumidification are variable according to levels of heat-loss obtained during ventilation and according to actual moisture content of the grain. An understanding of the interaction between grain and the atmosphere allows for optimum use of atmospheric resources, namely, sun, wind, and humidity of air, while minimizing energy inputs in their supplementation during the process of curing.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 42163, 42211, 42300, 42305, 43164, 43208

43325 (BMFT-FB-M—78-01) **Investigation of connection possibilities for an automated industrial fish farming in closed cooling circuit of large scale power plant.** Bettges, J.; Blank, K.; Johannsen, K.; Kroeger, W. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt. Anwendungstechnik). Nov 1978. 113p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

The report deals with pilot plants for intensive fish farming by means of utilizing water of an industrial process; direct utilization of cooling and effluent water from power stations (recycling); and automated installation for warm water fish culture.

43326 (CONF-7808102—) **Waste heat utilization: proceedings of 1978 Engineering Foundation conference.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Apr 1979. 327p. Dep. NTIS, PC A15/MF A01.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

A separate abstract was prepared for each of the 15 papers presented at the conference. (MCW)

43327 (CONF-7808102—, pp 20p, Paper 2) **Energy management systems for cogeneration.** Shinskey, F.G. (Foxboro Co., MA). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Generating electric power along with process steam is not only economically attractive, but also is an essential ingredient in our national energy-conservation program. Yet the performance of these generating facilities is entirely dependent on how carefully they are managed, particularly when one is faced with a wide range of electrical and steam loads, along with constraints imposed by equipment limitations and utility contracts. Most steam turbines and pressure regulators are designed to operate independently, and cannot be readily coordinated with other units. This paper describes the modifications necessary to accommodate the needed coordination, and the controls required to optimize performance of a typical multiturbine, multiheader facility. The economic and contractual factors associated with purchasing both steam and power are included in the solution.

43328 (CONF-7808102—, pp 15p, Paper 3) **High-effectiveness recuperators for waste heat recovery.** Parker, K.; Stake, R. (Garrett Corp., Los Angeles, CA). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Present furnace technology is the product of a lengthy production-oriented low-fuel-cost era during which there have been either no heat-recovery systems or, at best, systems of less than maximum efficiency. A new technology is available in the form of a high-effectiveness compact stainless steel recuperator to greatly increase the recovery of waste heat. Plate-fin heat exchangers such as the demonstration unit have reached a very high level of sophistication as a result of requirements in the aircraft and gas-turbine industry for compact, lightweight, low-cost units. Heat-transfer effectiveness in the range of 80 to 90 percent is readily obtainable and the volume of these high-effectiveness units is less than recuperators currently used for the same application. Because of the reduced volume, installation is often possible where low-effectiveness cross-flow or radiant tube units will not fit. Most important, the high-effectiveness recuperators increase fuel savings significantly, making their widespread application important for energy conservation. It is estimated that 350×10^{12} Btu per year of energy (valued at over $900,000,000 per year) can be saved by the use of $530,000,000 worth of high-effectiveness recuperators. This savings is sufficient to suppy the fuel needs of 5 million typical U.S. homes.

43329 (CONF-7808102—, pp 44p, Paper 4) **DOE/MTI cooperative venture to develop a product family for industrial waste heat power recovery.** Plunkett, J.; Colosimo, D.D. (Mechanical Technology, Inc., Latham, NY). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Energy cascading is the matching of the quality (temperature) of available energy to the needs of the tasks at hand. The available energy can be either direct fuel energy or rejected, and normally wasted energy, from another task. Mechanical Technology Incorporated (MTI) developed Rankine Power Recovery Systems, one of the numerous energy cascading approaches. DOE and MTI believe that Rankine Cycle Waste Heat Power Recovery Systems are economic and necessary for the nation's and industry's goals of energy conservation. MTI believe that its approach of using conventional and acceptable working fluids in a product family design to serve the full range of industrial waste-heat streams is the best market approach. MTI is currently completing its design specifications for that product family and will shortly be approaching industry to select demonstration sites. The paper briefly discusses the concept of the Rankine Power Recovery System, available waste streams as potential markets, user economics, product requirements, and DOE/MTI Cooperative Venture Program. (MCW)

43330 (CONF-7808102—, pp 14p, Paper 12) **Management techniques in waste heat utilization.** Scollon, R.B. (Allied Chemical Co., Morristown, NJ). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Allied Chemical, a diverse company, produces a wide variety of products ranging from basic industrial chemicals and specialty chemicals, to seat belts, synthetic fibers, coke, and agricultural chemicals. The company also produces oil, coal, natural gas, and nuclear fuels, and has developed and built a plant for processing spent nuclear fuels. Concerted effort to improve the energy efficiency of operations has resulted in improved efficiency of about 14% (as compared to 1972) with an estimated savings of about $40 million in 1978. Since the efforts were started, the company has developed and instituted what is believed to be the essential management techniques required to realize substantial energy savings. These guidelines have been compiled into an Energy Conservation Guidebook; two examples from the Guidebook pertinent to waste heat utilization are presented here, namely: (1) rejection of stack gases at the lowest practical level, and (2) minimizing water blowdown for each boiler steam unit.

43331 (CONF-7808102—, pp 26p, Paper 15) **Locating heat recovery opportunities.** Waterland, A.F. Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

The basic energy-conservation objectives are two-fold: (1) devise ways to get the job done with less net energy input; and (2) extract the greatest practical benefit from every unit of energy expended. Energy must be introduced at the highest practical level, then only grudgingly permitted to degrade to the lowest possible final rejection level. High energy rejection levels must be avoided and this really is what is meant by heat recovery. High-temperature heat rejections are potential sources of recovered heat. When energy can be picked up at a high rejection level and made to perform a useful function as it degrades to a lower rejection level, this is heat recovery. There are three ingredients of practical heat recovery: source, use, and heat transfer means. These were discussed by means of slides, all of which are presented. (MCW)

43332 (CONF-7808102—, pp 6p, Paper 5) **Waste heat application in the aluminum industry.** Brondyke, K.J. Apr 1978.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

An overview of the aluminum production process and major projects in each of the processes - mining, refining, smelting, and fabricating - to improve Alcoa's energy consumption are described. Smelting consumes 70% of the total energy consumed in Alcoa's operation. The benefit/cost ratio of recovering waste heat from the smelting cells is much lower than that of reducing its generation; so, the effort has been toward generating less waste heat rather than trying to recover it. The industry's interest in reducing the energy to smelt a pound of aluminum began in the 1940's with work on an aluminum chloride method to produce aluminum. Now, after 23 years and 25 million dollars, Alcoa has developed the Alcoa Smelting Process. Many other areas in the process to reclaim waste heat are mentioned. Of great importance to the aluminum industry is the opportunity for increased energy savings and waste heat utilization through recycling. Recycling saves 95% of the energy required to produce molten metal from bauxite. Today Alcoa remelts about 100 million pounds of scrap per year, a 1% reduction in melt loss will net an additional million pounds of metal. It also nets an additional 100 billion Btu's of energy not required to produce virgin metal. (MCW)

43333 (CONF-7808102—, pp 37p, Paper 6) **600-kW organic Rankine cycle waste heat power conversion system.** Lacy, P.D. Apr 1978.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

Schematics, tables, graphs, pictures, maps, and program schedules are presented to describe the 600-kW Organic Rankine Cycle Waste Heat Power Conversion System. Caption designations are: Sundstrad Organic Rankine Cycle programs; Bottoming System Payback; Projected Fuel Costs; Average Industrial Rates per kWh; Bottoming Cycle; 600-kW ORC System Parameters; Program Schedule; 600-kW ORC Bottoming System; 600-kW ORC Schematic; (300 and 200 psi system); Field Test Sites; Facts on Homestead, Florida Municipal Utility; Facts on Easton, Maryland Municipal Utility; Facts on Beloit, Kansas Municipal Utility; Facts on Foundry; Facts on Glass plant; 600-kW ORC Schematic Liquid Heat Source; 600-kW ORC Driven Air Compressors; Economics of Bottoming; Factors That Determine Economics; Annual Savings From 600-kW ORC; Return on Investment and Installed Cost; and Annual Savings in Fuel Cost. (MCW)

43334 (HCP/M5056—01) **High COP Heat Pump System. Phase I. Results. Technical report No. 1.** (Mechanical Technology, Inc., Latham, NY (USA)). Apr 1979. Contract EC-77-C-01-5056. 151p. Dep. NTIS, PC A08/MF A01.

The High COP Heat Pump System described is a device for recovering heat or energy usually lost in process streams by rejection to once-through cooling systems. The acetone recovery process makes use of river water to cool process streams, with the river water taking on heat in the heat exchange process. Heat or energy is thereby rejected from the process stream and is not recovered for reuse. The MTI Heat Pump System allows reuse of this energy. The estimated cost of a production Heat Pump System is $625,000 plus installation. The system can deliver 20 million BTU's per hour of latent steam energy. Based on a steam cost of $1.89 per million BTU's for natural gas, the system being in service for 7884 hours per year (90% in-service rate), a 20% investment tax credit and installation costs at 50% of hardware costs; the discounted cash flow rate of return is 29.5%. Breakeven points are 2.6, 3.6, and 4 years for oil, gas and coal respectively. Details are provided about the Heat Pump System operation in the section entitled Process Description. Cycle Optimization is discussed, providing insight on the technique of determining the optimum system configuration. System Sensitivity shows how relatively little the output varies with changes in turbine and compressor efficiencies. Details of System Design are given, in which design objectives, applicable codes, working fluid, general arrangement, and component design features are discussed. Installation at the host site is analyzed, as is System Cost. Under Environmental Effects, it is shown that the Heat Pump System will increase the quality of the environment.

43335 **180° water from refrigeration compressors.** Sturges, P. (Sturges Heat Recovery, Stone Ridge, NY). pp 123-129 of NESEA '77: better thermal utilization. Shaw, E.; Beebe, R. (eds.). Brattleboro, VT; New England Solar Energy Association (1977).

From 2. conference of the New England Solar Energy Association; Hartford, CT, USA (8 Sep 1977).

This heat recovery system uses a distiller's worm coil welded into a vertical range boiler. The hot discharge line runs from the compressor to the top of this coil, then out the bottom and to the inlet of the regular condenser. The cold water line for the water heater runs first to the baffled inlet of the new heat exchanger, then out the top to the cold water inlet of the water heater. Over 20 years experience with the system and the economics obtained are reviewed briefly. (MHR)

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 42224, 42227, 42229

43336 (PB—287511) **Availability of mining wastes and their potential for use as highway material - executive summary. Final summary report Jun 75—Jun 76.** Collins, R.J.; Miller, R.H. (Valley Forge Labs., Devon, PA (USA)). Sep 1977. Contract DOT-FH-11-8784. 47p. NTIS PC A03/MF A01.

This study was performed to determine the availability of mining and metallurgical wastes in the United States and to assess their potential for use in various aspects of highway construction. A comprehensive literature survey was performed to develop information on locations amounts, compositions, and uses of various mining and metallurgical wastes.

43337 (PB—287769) **Alternatives to Type II cement. Final report.** Ozyildirim, H.C. (Virginia Highway and Transportation Research Council, Charlottesville (USA)). Jul 1978. 49p. NTIS PC A03/MF A01.

Concrete mixtures incorporating fly ash were investigated as possible alternatives to mixtures using Type II cements. The mixture characteristics considered were strength, resistance to freezing and thawing and sulfates, heat of hydration, and volume stability. This final report presents the data on the initial testing program not included in the interim report and describes the second testing program. In general, the results indicate that concretes containing IP or Type I cement with fly ash can be an acceptable alternate to Type II; however, it should be recognized that more scaling in the presence of deicers may be expected.

43338 (SAND—79-7034C) **Pathway: a computer model to determine sewage sludge pathogen transport through environmental pathways.** Sheridan, R.E.; Abernathy, M.F.; Yeager, J.G. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 22p. (CONF-790367—1). Dep. NTIS, PC A02/MF A01.

From 8. national conference and exhibition on municipal sludge management; Miami Beach, FL, USA (19 Mar 1979).

A computer program is presently being developed to model the transport of pathogens through environmental pathways as a result of the application of treated sewage sludge. Specific sludge application cases include the use of treated sludge as a cropland fertilizer, a soil conditioner by the general public, and as a feed supplement for ruminant animals. Environmental pathways from the point of sludge production to points of potential human contact have been defined. Along these pathways, discrete points have been designated where it is desired to compute pathogen population. Each point in these pathways is treated as a mathematical state. The transfer of pathogens between these states is described by a set of ordinary differential equations derived using conservation principles, environmental parameters, and relationships developed from data obtained in the literature review. These equations are then integrated to determine the pathogen populations at each state. This computerized model will describe pathogen transport through environmental pathways and should help predict the risk associated with certain sludge utilization and treatment practices.

MUNICIPALITIES AND COMMUNITY SYSTEMS

43339 (ANL/CES/TE—78-7) **Steam turbines.** Meador, J.T. (Oak Ridge National Lab., TN (USA)). Oct 1978. Contract W-31-109-ENG-38. 110p. Dep. NTIS, PC A02/MF A01.

The selection, classification, and average shaft efficiencies are discussed of some small-to-medium size steam turbines that can be used for base-load, turbine-generator units to meet both the electrical and thermal energy demands of several communities, as specified in evaluations for Integrated Community Energy Systems (ICES). Shaft efficiencies are evaluated by combining the average internal turbine efficiencies and the Rankine steam-cycle efficiencies for several combinations of steam inlet conditions under conditions of both fully condensing and non-condensing exhaust steam. Efficiencies of very small turbines for mechanical drive of compressors or power plant auxiliaries also are estimated. A diagram, based on vapor studies, depicts the relationship of inlet steam pressure and degrees of superheat recommended for various exhaust temperatures. Combinations of shaft efficiency and potenially usable energy in the exhaust steam could help optimize operating steam conditions for a dual-purpose plant. Two examples are given of the input data necessary to establish preliminary costs for an industrial-extraction type turbine that may be adapted to ICES. Some data on operational considerations and cost factors are included.

43340 (ANL/ICES-TM—27) **Heat pump centered integrated community energy systems: system development. Rocket Research Company interim report.** (Rocket Research Corp., Redmond, WA (USA)). Feb 1979. Contract W-31-109-ENG-38. 105p. Dep. NTIS, PC A06/MF A01.

Heat Pump Centered Integrated Community Energy Systems (HP-ICES) are energy systems for communities which provide heating, cooling, and/or other energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources, rather than convert it from electrical or chemical to thermal form, HP-ICES are viewed as having significant potential for energy conservation. Furthermore, since conventional building heating and cooling systems would be replaced by this community energy system, nonscare resources could be used instead of depleting fuels which are in short supply. This is accomplished by powering the heat pumps with nonscare energy forms not practical for use in the smaller conventional systems. Secondary benefits expected to enhance the value of such systems include reduction of adverse environmental effects over conventional systems, reliable production of services in view of increasingly frequent utility curtailments and interruptions, and provision of services at costs more favorable to consumers than conventional system costs (including acquisition, operation, and maintenance). The System Development Phase of the HP-ICES Project is described and the results are reported. The objective of this multiphase project is development and demonstration of HP-ICES concepts leading to one of more operational systems by the end of 1983. The seven phases inlude System Development, Demonstration Design, Design Completion, HP-ICES Construction, Operation and Data Acquisition, HP-ICES Evaluation, and Upgraded Continuation.

43341 (ANL/ICES-TM—28) **Heat pump centered integrated community energy systems: system development. Georgia Institute of Technology interim report.** Wade, D.W.; Trammel, B.C.; Dixit, B.S.; McCurry, D.C.; Rindt, B.A. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.; McCurry and Associates, Inc., Atlanta, GA (USA)). Feb 1979. Contract W-31-109-ENG-38. 201p. Dep. NTIS, PC A10/MF A01.

Heat Pump Centered-Integrated Community Energy Systems (HP-ICES) show the promise of utilizing low-grade thermal energy for low-quality energy requirements such as space heating and cooling. The Heat Pump - Wastewater Heat Recovery (HP-WHR) scheme is one approach to an HP-ICES that proposes to reclaim low-grade thermal energy from a community's wastewater effluent. The concept of an HP-WHR system is developed, the potential performance and economics of such a system is evaluated and the potential for application is examined. A thermodynamic performance analysis of a hypothetical system projects an overall system coefficient of performance (C.O.P.) of from 2.181 to 2.264 for wastewater temperatures varying from 50°F to 80°F. Primary energy source savings from the implementation of this system is projected to be 5.014 QUADS, or the energy equivalent of 687 millions tons of coal, from 1980 to the year 2000. Economic analysis shows the HP-WHR scheme to be cost-competitive, on the basis of a net present value life cycle cost comparison, with conventional residential and light commercial HVAC systems.

43342 (ANL/ICES-TM—29) **Heat pump centered integrated community energy systems: systems development. Dubin—Bloome Associates interim report.** Dubin, F.S.; Halfon, A.; Herzog, P. (Dubin-Bloome Associates, New York (USA)). Feb 1979. Contract W-31-109-ENG-38. 242p. Dep. NTIS, PC A11/MF A01.

A Heat Pump Centered Integrated Community Energy System (HP-ICES) which should provide all the heating, cooling, and other energy requirements to an entire community is described. The ice generating HP-ICES uses the heat of fusion of water as a heat source for the heat pump, thus converting the water into ice. The ice will be stored in a bin and used the following summer for cooling which, therefore, could be considered a by-product of heating. The annual overall coefficient of performance (COP) is expected to reach a value of 4.85 and related to source energy a value of 4.85 x 0.31 = 1.5. This is greater than 0.713, the value for which the HP-ICES would perform equally well with conventional system having the same cooling and heating output. Actually the HP-ICES performs better than a conventional system operating even with 100% boiler efficiency and a cooling COP equal to 5. In a case study performed on Market Square, Washington, DC it was shown that for the HP-ICES the annual energy cost are 50% of the corresponding values for the conventional system. The annual operating cost of the HP-ICES is 73% of the annual operating cost for the conventional while its first cost is 90% greater than the first cost of the conventional system. This leads to a pay-back of 11 years calculated with a 10% interest rate and a 12% escalation rate for the operating cost. The rate of return calculated over a period of 20 years with the same escalation rate is 18%. It is therefore, obvious that the HP-ICES is both energywise and costwise more feasible than a conventional system of the same cooling and heating output and holds great promises to be an energy saving and an attractive system.

43343 (ANL/ICES-TM—31) **Heat pump centered integrated community energy system: system development. Honeywell Energy Resources Center interim report.** (Honeywell, Inc., Minneapolis, MN (USA). Energy Resources Center). Mar 1979. Contract W-31-109-ENG-38. 153p. Dep. NTIS, PC A08/MF A01.

Heat Pump Centered-Integrated Community Energy System (HP-ICES), based on the use of privately owned heat pumps in each building within a community, is described. The heat pumps will provide all of the space heating, space cooling and domestic hot water needs. All of the energy required is provided by electrical power, thereby eliminating a community's dependence on gas or oil supplies. The electrical power can be generated using any available fuel. The heat pumps will operate in both air and water source modes, deriving the best performance advantages of both. The water source, provided to the users by a community-owned distribution system dedicated to HP-ICES use, is closed-loop. During most of the winter heating season, the heat pumps will operate from the

community water source, extracting the latent heat of the water and thereby producing ice. This ice will be pumped back into the same community main from which the water was originally withdrawn. Thus, the community water main becomes, in addition to a simple water supply, an energy slush fund from which individual users can draw as required. The resdences draw off water and return ice; the commercial buildings draw off chilled water and/or ice and return warmed water. The analyses performed during this program show that HP-ICES applications will result in significant energy savings, in terms of raw resources over conventional heat pumps and oil and gas furnaces. From an economic viewpoint, HP-ICES can compete with all the alternative systems given the right application in terms of geographical location and competing energy and power rate structures. Therefore, it is concluded that the basic HP-ICES concept is viable, both from an economic and energy use viewpoint.

43344 (CONF-790659—2) **Twin cities institutional issues study cogenerated hot water district heating.** Sundberg, R.E.; Leas, R.; Kolb, J.O. (Minnesota Energy Agency, St. Paul (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

From International district heating association 1979 annual conference; Dixville Notch, NH, USA (19 Jun 1979).

Community district heating, utilizing hot water produced through electrical/thermal cogeneration, is seen as an integral part of Minnesota's Energy Policy and Conservation Plan. Several studies have been conducted which consider the technical and institutional issues affecting implementation of cogenerated district heating in the Minneapolis and St. Paul Metropolitan Area. The state of the technical art of cogenerated hot water district heating is assumed to be transferable from European experience. Institutional questions relating to such factors as the form of ownership, financing, operation, regulation, and product marketability cannot be transferred from the European experience, and have been the subject of an extensive investigation. The form and function of the Institutional Issues Study, and some of the preliminary conclusions and recommendations resulting from the study are discussed.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 42157, 42851, 42856, 43238, 43245, 43246, 43273

43345 **Control of the street lighting an additional task of the SCA-systems.** Czyzak, A. (Biurno Studiow i Projektow Energoprojekt, Poznan, Poland). *Energetyka;* 32: No. 6, 219-221(Jun 1978). (In Polish).

The expediency of the SCA-system application to street lighting control instead of twilight relays and control clocks is discussed. Special attention is called to the case where the transmitter cost is amortized by the savings resulting, e.g., from the 24 hours load characteristic adjustment. Some faults of the twilight relays and control clocks are discussed. The application range of the SCA-systems is determined.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 43632

43346 (PB—287512) **Guidelines for use of incinerator residue as highway construction material. Final report Jul 74—Sep 77.** Collins, R.J.; Miller, R.H.; Ciesielski, S.K. (Valley Forge Labs., Devon, PA (USA)). Sep 1977. Contract DOT-FH-11-8540. 99p. NTIS PC A05/MF A01.

The report contains background information on the composition and characteristics of basic types of incinerator residues. A recommended classification system is presented. The use of incinerator residues in structural fill, stabilized base, and bituminous paving applications is discussed. Included are specific recommendations for materials handling and preparation, laboratory testing procedures, engineering properties, and design and construction procedures for these applications. The manual also includes recommended laboratory test procedures for determining the loss on ignition and physical composition of incinerator residue samples. A separate section is devoted to a summary of situations which are favorable, as well as unfavorable, to the utilization of municipal incinerator residue in highway or street construction.

43347 (TI—79-3) **Influence of color mixture on the use of glass cullet recovered from municipal solid waste.** Duckett, E.J. (National Center for Resource Recovery, Inc., Washington, DC (USA)). Mar 1979. 17p. National Center for Resource Recovery, Inc., Washington, DC.

Glass can be removed from municipal refuse as cullet for use in the manufacture of new glass containers. Among the four U.S. resource recovery plants designed for recovery of cullet, three will employ a froth flotation process and will produce a color-mixed cullet. Color-mixed cullet contains iron and chrome oxides used in coloring amber and green container glass. Limits to the use of color-mixed cullet are calculated based on reported concentrations of iron and chrome oxides in recovered cullet and on tolerances for these chemicals in container glass. The use of color-mixed cullet in flint (clear) container glass is limited primarily by the concentration of chrome oxide in the cullet. Approaches to expanding this limit and for monitoring chemical colorant levels in cullet are reviewed.

43348 (TI—79-5) **Technological barriers to the reuse of aluminum recovered from municipal refuse.** Duckett, E.J. (National Center for Resource Recovery, Inc., Washington, DC (USA)). Mar 1979. 31p. National Center for Resource Recovery, Inc., Washington, DC.

Aluminum recovered from mixed municipal waste may contain metallurgical and/or organic contaminants that will lessen its utility. The potential barriers to the use of recovered aluminum are discussed and methods for overcoming these barriers are described. (LCL)

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 43216, 43217

43349 (PB—287344) **Home energy cost-cutting clinic. Training manual.** Naismith, R.; Swope, S.; Callander, R.S. (Atlantic Research Corp., Alexandria, VA (USA)). Aug 1978. 116p. NTIS PC A06/MF A01.

This document includes text and figures used in Virginia state-wide homeowner energy education programs. It has been successfully used in over 400 presentations to over 30,000 citizens. The text includes instructions for presenters as well as the actual program material which includes a discussion of how heat flows, how energy is used in the home, and methods for reducing energy use.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

43350 (PB—287406) **The relationship of automobile characteristics to list prices and profit margins -- a preliminary analysis. Final report, November 1976-November 1977.** Cassella, M.A.; Rabe, F.T. (Eic, Inc., Newton, MA (USA)). Aug 1978. Contract DOT-TSC-1311. 56p. NTIS PC A04/MF A01.

The report describes research on potential impacts of fuel economy regulations on the U.S. automobile industry. The study focused on the possible effects of auto 'down-sizing' on manufacture profit margins. Historical price data were used to estimate variable profit margins. Estimated margins were strongly correlated with vehicle inertia weight and the price of the average options packages and, to a lesser extent, were negatively correlated with production volume. Regression analyses were also performed to relate list prices to vehicle characteristics believed to represent valuable attributes to consumers. The results, although ambiguous, suggest that vehicle roominess, fuel economy, and power-to-weight ratio are positive influences on prices. However, the extent and quality of the data employed in the analyses were too limited to support firm general conclusions. Further study is required to anticipate the long term effects of the fuel economy regulations on price.

43351 (PB—287543) **Influence of tread depth on commercial vehicle fuel consumption. Interim report.** Clark, S.K. (Michigan Univ., Ann Arbor (USA)). May 1977. Contract DOT-OS-50113. 12p. NTIS PC A02/MF A01.

Decreased tire tread depth will result in reduced fuel consumption in trucks. This effect is evaluated quantitatively for both bias and radial truck tires using a typical highway truck configuration as an example.

43352 **Exhaust gas heat system utilizing a heat pipe.** Beauvais, F.N.; Clemens, W.J. (to Ford Motor Co.). US Patent 4,146,176. 27 Mar 1979. Filed date 14 Nov 1977. 6p.

The invention discloses a heating system for a vehicle passenger compartment, the vehicle being propelled by an internal combustion engine having an exhaust system that includes a catalytic converter for exhaust gas emission control. The vehicle passenger compartment has a conventional heater case containing air distribution channeling ducts, air outlets, control valves and a blower for forcing air through the ducts. A heat pipe coupled to a heat exchanger located in the engine exhaust system down-stream of the catalytic converter is utilized to transfer exhaust gas heat to the heater case thereby eliminating the conventional heater core, and its related plumbing, that utilizes engine coolant as a heat source.

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 43369, 43371, 43374, 43375, 43376, 43377, 43378

43353 Electronic feedback control system for fuel injection in internal combustion engines of fuel injection type. Aoki, K. (to Toyota Jidosha Kogyo Kabushiki). US Patent 4,145,999. 27 Mar 1979. Priority date 22 Mar 1976, Japan, 6p.

The invention discloses an electronic system for fuel injection in internal combustion engines of the fuel injection type including a system which modifies the pulse length of the fuel injection control pulses by integration of an on-off signal delivered from an air/fuel ratio sensor wherein the integration time constant is varied in accordance with the frequency of the on-off signal from the air/fuel ratio sensor so tha the rate of increasing the injection quantity of fuel is increased in accordance with an increase in the engine intake air flow.

43354 Device for heating a carburetor. Sigwald, J. (to Automobiles Peugeot). US Patent 4,148,287. 10 Apr 1979. Priority date 30 Apr 1976, France, 4p.

The device comprises an auxiliary heating liquid circuit connected to the main cooling liquid cricuit of the engine on the suction side of the cooling circuit pump. The cooling circuit has an expansion chamber containing a gaseous phase. The heating circuit has a loop portion constituting a siphon whose upper point is located at a level above the level of the liquid in the expansion chamber. A pipe connects the loop portion to the upper part of the expansion chamber and is located throughout its path above the level of the liquid in the expansion chamber.

43355 Fuel atomizing device and method for gasoline engine. Ahlers, W.P. (to Fuel Systems of Minnesota). US Patent 4,148,285. 10 Apr 1979. Filed date 28 Feb 1977. 4p.

The invention consists of a plate-like member disposed between the carburetor and the intake manifold of an internal combustion engine and has a bore therethrough in register with the throat of the carburetor and the intake of the manifold. The plate-like member has an unobstructed annular air inlet into its bore and a passage across the bore having a jet nozzle axially of the bore directed at the intake of the manifold, the air stream from the annular inlet diverts the fuel and air mixture from the carburetor to be confined centrally of the bore and the jet stream of air from the jet nozzle creates a virtual venturi to cause the incoming fuel and air mixture to flow directly through the core of the intake of the manifold without engaging the side walls thereof, the impact of the intersection of the air stream from the annular inlet and the jet stream together with the fuel and air mixture from the carburetor causes a cyclonic action which further atomizes the fuel and air mixture and increases its homogenity upon entering the intake of the manifold for a more complete combustion.

43356 Variable compression ratio engine. Prosen, G.G. (to Promac Corp.). US Patent 4,148,284. 10 Apr 1979. Filed date 10 Feb 1977. 8p.

A two-part variable compression ratio cylinder is provided having inner and outer sleeves wherein relative movement between the sleeves varies the volume of the combustion chamber and hence varies the compression ratio of the engine. Hydraulic means responsive to the pressure in the combustion chamber automatically varies the position of the inner and outer sleeves to regulate the combustion chamber volume. The hydraulic controls are located entirely in the cylinder head facilitating the conversion of any internal combustion engine without altering the piston size.

43357 Fuel modification system for internal combustion engines. Little, A.V.; Wilkinson, R.A. US Patent 4,147,142. 3 Apr 1979. Priority date 14 Mar 1975, Australia, 20p.

The invention discloses an apparatus for modifying fuel, including a housing heatable by exhaust gases to effect vaporization and/or thermal cracking and a catalytic reactor for catalytic cracking of the vaporized and/or thermally cracked fuel, the reactor providing gaseous fuel for supply to the engine fuel induction system; and an engine having a fuel supply system incorporating such apparatus.

43358 Carburetion system for internal combustion motor. Furucz, I. US Patent 4,147,144. 3 Apr 1979. Priority date 13 Aug 1976, Canada, 28p.

The a disclosure describes a carburetion system for an internal combustion motor which operates with a mixture of vapor fuel and air. The system comprises: a carburetor which is characterized by operating as a continuous injection system, and a removable heat exchanger which is incorporated into the admission system before the exhaust system, in order to heat the admission system. The carburetor is supplied under constant pressure through a pressure regulator which enables to vary the pressure of the fuel depending on the operating conditions and the behavior of the motor in general; moreover, the carburetor is provided with automatic control means to regulate the proportion of the quantities of air which accompany the formation of vapor fuel and the heat exchanger; finally, this system enables to limit the premature expansion of the combustible mixture which is introduced into the combustion chambers.

43359 Internal combustion engine with an auxiliary combustion chamber. Yokota, M.; Katayama, T. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,147,150. 3 Apr 1979. Priority date 21 Dec 1976, Japan, 10p.

Disclosed is an internal combustion engine comprising a main combustion chamber and an auxiliary combustion chamber which are interconnected with each other via a first connecting passage. A second connecting passage communicating the first connecting passage with the main combustion chamber is further provided. The spark plug is disposed in the second connecting passage. The combustible mixture in the main combustion chamber passes through the second connecting passage due to the pressure difference between the static pressure at a position where the second connectin passage opens into the first connecting passage and the static pressure at a position where the second connecting passage opens into the main combustion chamber.

43360 Effect of exhaust gas recirculation and turbulence on the burning velocity, quenching distance, and minimum ignition energy in a premixed methane--air combustion. Gat, N. Cincinnati, OH; Univ. of Cincinnati (1978). 341p. University Microfilms Order No. 7821566.

Thesis (Ph. D.).

The effects of Exhaust Gas Recirculation (EGR) and turbulence on several combustion phenomena was studied in a relatively large constant volume bomb (approximately 62.8 liters). With natural gas as fuel, the pressure rise during the early period of the explosion was found to slightly differ from the conventional pressure-time relationship reported in various studies utilizing a small volume bomb. Quantitative relationships were obtained for the burning velocity as a function of turbulence for levels of EGR ranging from zero to 30%. The single wall quenching distance was studied by means of two methods. In the first, a set of ionization gauges, located in close proximity of the cold quenching surface, was utilized to indicate the location of a flame propagating normal to the wall. In the second, a surface temperature probe measured the instantaneous heat flux to the wall during the flame/wall interaction. The peak heat flux was employed for calculation of the quench layer thickness according to the thermal theory of flame quenching. Both methods gave results of similar magnitude, although the quenching distances obtained through the heat flux method were consistently larger than those obtained through the ionization gauges. Turbulence reduced the quenching distance while mixture dilution by the exhaust gas significantly increased that distance. The required ignition energy, a strong function of the mixture dilution, increased by a factor of 100 as EGR level increased from zero to 30%. Turbulence further augmented the required ignition energy. Hydrogen enrichment of the fuel increased the burning velocity in the diluted mixture, and slightly reduced the quench layer thickness.

SPARK-IGNITION

43361 Engine intake stratifier. Firey, J.C. US Patent 4,147,137. 3 Apr 1979. Filed date 10 Nov 1976. 56p.

The devices of the invention, when used in combination with internal combustion engines of spark ignition type and/or compression ignition type, can create a multiregional stratification of the intake air-fuel mixture. By use of multiregional stratification at intake various beneficial objects can be achieved including the following: reduction of engine exhaust emissions of undesireable oxides of nitrogen, improvement of engine efficiency, reduction of engine noise, reduction of engine exhaust smoke, reduction of engine cost and others. The multiregional stratified air-fuel mixture is created by a stratifier valve which selects differing kinds of air-fuel mixtures in sequence from several different mixture creating channels. The resulting multiregional stratified mixture passes from the stratifier valve to the engine intake. Within the engine cylinder this subsequently compressed multiregional stratified mixture may be spark ignited, or compression ignited, or ignited by both spark and compression means.

DIESEL

REFER ALSO TO CITATION(S) 43361

43362 Fuel control apparatus for a diesel engine. Ito, M.; Saito, T.; Morita, Y. (to Nippon Denso Co. Ltd.). US Patent 4,147,148. 3 Apr 1979. Priority date 19 May 1977, Japan, 6p.

A fuel control apparatus for a diesel engine is provided with a control lever which reciprocates between two positions under control of a motor shaft which rotates in one direction only. The control lever connects to a fuel control lever which is moved from a fuel shut-off position to a starting fuel increasing position and then to a normal fuel supply position in accordance with the movement of the control lever. Motor control is effected by relay control in accordance with the positions of a key switch, a pattern switch rotating angularly with the motor shaft, and a switch which determines whether the engine is rotating or at rest.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 43365, 43366, 43367, 43368, 43369

43363 Economic use of electric road vehicles in a changing environment. London, England; Peter Peregrinus Ltd. (1978). 106p. (CONF-780582—). Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

From International conference on the economic use of electric road vehicles in a changing environment; Sheffield, UK (23 May 1978).

Thirteen papers were presented at the meeting. A separate abstract was prepared for each of 12 papers. The remaining paper was not in scope for the data base. (LCL)

43364 United States electric and hybrid vehicle program. Purple, R.A. pp 33-35 of Economic use of electric road vehicles in a changing environment. London, England; Peter Peregrinus Ltd. (1978).

From International conference on the economic use of electric road vehicles in a changing environment; Sheffield, UK (23 May 1978).

The history of electric vehicle production and use in the U.S. is reviewed, and the effect of the Electric and Hybrid Vehicle Research Development and Demonstration Act of 1976 on the present development of electric vehicles to meet transportation requirements while lowering the fuel consumption and adverse environmental effects of internal combustion engines is discussed. (LCL)

HYBRID SYSTEMS

43365 (CONF-781046—, pp 14-25) **Impact of mechanical-energy-storage-device addition on the performance of electric vehicles.** McAlevy, R.F. III. (Robert F. McAlevy III and Associates, Hoboken, NJ). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

Electric vehicle (EV) power and energy balances were used to establish battery requirements as a function of vehicle mission specification. Normal freeway/urban commuter car driving patterns were found to require battery power capabilities in excess of those forecast for this century. However, Ni/Zn and other batteries should permit EV's to follow normal urban commuter car driving patterns. A criterion for the optimum battery is evolved and used to delineate between power-determined (battery mass in excess of that needed to meet range specification) and range-determined EV designs. The impact of adding a mechanical-energy-storage, MES, device to an EV depends strongly on the baseline EV design. For range-determined EV's, analytical relationships are developed for the maximum MES device mass permitted as a function of energy-efficiency increment produced, so that there will be no change in: (a) vehicle mass and (b) vehicle energy consumption, compared to the baseline EV. The limiting case of MES device mass approaching zero (e.g., infinite power-density and energy-density) while the increment of energy-efficiency remains is also examined. Therefore, the boundaries of beneficial MES device application to range-limited EV's has been established. Presently, the analysis is being extended to EV's of power determined design, where the payoff for MES device addition can be much greater, and to ICE vehicles.

43366 (CONF-781046—, pp 28-32) **Advanced flywheel energy storage unit for a high power energy source for vehicular use.** Raynard, A.E. (AiResearch Manufacturing Co. of California, Torrance). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The maximum benefits that may be gained by the incorporation of mechanical energy storage (MES) into vehicular propulsion systems are obtained by combining the concepts of load-leveling the prime energy source(s), and recovering vehicle kinetic energy by regeneration. These benefits are intuitively achievable and large, and have been indirectly demonstrated in past programs. There is a pressing need for the verification of these benefits in a structured program designed for that purpose. The verification, or lack thereof, is needed to give direction and emphasis to future MES component and system development. The paper describes an experimental program that characterizes the magnitude of the benefits in a flywheel propulsion system. The first step in the program will be to experimentally determine the performance of a hermetically-sealed flywheel system that has been optimized for an electric or hybrid vehicle. The flywheel system has been designed and the design tradeoffs are described.

43367 (CONF-781046—, pp 34-42) **Regenerative flywheel energy storage system.** Lustenader, E.L. (General Electric Co., Schenectady, NY). 1978.

From 1. information exchange conference; Luray, VA, USA (24 Oct 1978).

The progress to date on the laboratory development and evaluation of a regenerative flywheel energy storage system is described. The system has been designed specifically for a battery/flywheel electric vehicle in the 3000 pound class. Planned laboratory tests will simulate this electric vehicle operating over the SAE J227a Schedule D driving cycle. The range improvement attributed to the use of the flywheel will be established. The flywheel energy storage system will consist of a solid rotor, synchronous inductor-type flywheel drive machine electrically coupled to a dc battery electric propulsion system through a load commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which regenerates the vehicle's braking energy. The laboratory simulation of the battery/flywheel propulsion system will include a 108 V lead-acid battery bank, a separately excited dc propulsion motor coupled to a flywheel which simulates the vehicle's inertia, and the flywheel energy storage system comprised of the motor/flywheel unit, the load commutated inverter and its control.

43368 (UCRL—82710) **Effect of mechanical energy storage systems on the characteristics of electric vehicles.** Schwartz, M.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 May 1979. Contract W-7405-ENG-48. 7p. (CONF-790803—17). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Batteries for electric vehicle propulsion can be developed to effect trade-offs between short-term peak power capability and energy storage capacity. Such batteries in combination with a mechanical energy storage device can optimize both power and range capability of an electric vehicle. Equations are derived for determining the vehicle mass fraction of the mechanical energy storage system that is required to achieve a vehicle mass saving or increase in range. The extent to which mechanical energy storage systems can improve electric vehicle performance depends upon the battery type and the vehicle power/mass requirements.

43369 Internal combustion electric power hybrid power plant. Cummings, T.A. US Patent 4,148,192. 10 Apr 1979. Filed date 23 Nov 1977. 4p.

An internal combustion-electric motor hybrid power plant for an automotive vehicle is disclosed. The power plant includes an internal combustion engine and a direct current electric motor generator which are connected to a drive shaft for the vehicle. A clutch mechanism is provided to connect the internal combustion engine, the direct current electric motor generator and the drive shaft for selectively engaging and disengaging the drive shaft with the internal combustion engine and the motor generator. A storage battery is electrically connected to the motor generator to supply current to and receive current therefrom. Thermoelectric semiconductors are arranged to be heated by the waste heat of the internal combustion engine. These thermoelectric semi-conductors are electrically connected to the battery to supply current thereto. The thermoelectric semi-conductors are mounted in contact with the outer surfaces of the exhaust pipe of the internal combustion engine and also with the outer surfaces of the cylinder walls of the engine.

FLYWHEEL PROPULSION

REFER ALSO TO CITATION(S) 43153, 43154, 43365, 43366, 43367, 43368

EMISSION CONTROL

REFER ALSO TO CITATION(S) 43359, 43360

43370 (DOE/TIC—10345) **Analysis of effects of several specified alternative automobile emission control schedules upon fuel economy and costs.** (Department of Commerce, Washington, DC (USA); Department of Transportation, Washington, DC (USA); Energy Research and Development Administration, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA); Federal Energy Administration, Washington, DC (USA)). Feb 1977. 45p. Dep. NTIS, PC A03/MF A01.

The analysis compares the differential fuel economy and cost effects of several schedules for implementing more stringent automobile emission control standards. The analysis was prepared in response to a request by the Office of Management and Budget. It is based principally upon an analysis prepared for Congressman John Dingell by DOT, EPA, and FEA (April 8, 1976) which has been modified to reflect more current information, where possible. Both the DOT and EPA are currently conducting more extensive analyses that bear on this topic and which, when completed, may indicate a need to modify this analysis.

43371 **Exhaust gas recirculation system for an internal combustion engine.** Kohama, T.; Obayashi, H.; Ozaki, T.; Nohira, H. (to Nippon Soken, Inc.). US Patent 4,148,286. 10 Apr 1979. Priority date 1 Oct 1976, Japan, 10p.

The disclosed engine exhaust gas recirculation (EGR) system has an EGR passage for recirculating exhaust gases from an exhaust system of an engine back into an intake system thereof downstream of a throttle valve. The EGR passage has a restriction orifice therein and an EGR control valve responsive to a vacuum signal to control the recirculation of exhaust gases through the EGR passage. A pressure comparator and modulator is pneumatically connected to the EGR passage upstream and downstream of the restriction orifice, to the carburetor venturi, to the intake manifold and to the EGR control valve and operative to compare the venturi vacuum with the exhaust gas pressure difference across the restriction orifice thereby to modulate the intake manifold vacuum to be fed to the EGR control valve so that the latter is controlled by the thus modulated vacuum to keep the exhaust gas pressure difference proportional to the venturi vacuum whereby the volumetric quantity of recirculated exhaust gases is made proportional to the volumetric quantity of engine intake air.

43372 **Emission control system dependent upon transmission condition in a motor vehicle.** Kodama, M.; Kobayashi, T. (to Fuji Heavy Industries Co., Ltd.). US Patent 4,148,230. 10 Apr 1979. Priority date 14 Dec 1976, Japan, 10p.

The invention discloses an emission control system for a motor vehicle equipped with an automatic transmission having a band servo system including switching means for detecting the state of the band servo system and two vehicle speed switches respectively susceptible to two different vehicle speeds V_1 and V_2 ($V_1 < V_2$). The emission control system includes means for enriching the air-fuel ratio of the air-fuel mixture in an intake passage of the engines and exhaust gas recirculating means are so arranged that the air-fuel ratio of the air-fuel mixture is normally set on the rich side and the EGR ratio is made high. Correspondingly in the high driving range with a vehicle speed of lower the V_2 the EGR ratio is made low, and in the high driving range with a vehicle speed of at least V_2 the EGR ratio is made low and the air-fuel ratio is released from being set on the rich side.

43373 **Internal combustion engine equipped with catalytic converter.** Tokura, N. (to Nissan Motor Co., Ltd.). US Patent 4,148,188. 10 Apr 1979. Priority date 6 Feb 1976, Japan, 6p.

Above a selected temperature the amount of fuel supplied into the air stream inducted into the combustion chamber is controlled so that the resulting air-fuel mixtures cause exhaust gases having air-fuel ratios of 145:1 to 15.5:1 whereby neither hydrogen sulfide nor sulfuric acid mist is formed in an oxidation type catalytic converter.

43374 **Exhaust gas purifying system for engines.** Siki, K. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,148,189. 10 Apr 1979. Filed date 18 Mar 1977. 6p.

The invention discloses an exhaust gas purifying system for automobile engines or like engines of the type injecting a secondary air for burning the unburned part of the exhaust gases produced in an engine and more particularly an improved purifying system of the type whereby the injection is automatically cut off especially when the engine speed is rapidly decelerated, accelerated, or the engine runs under high loads, in which an air injection conduit is closed by the action of a valve which is actuated by detecting a drop or decrease in a suction vacuum in the engine as the engine is increasing its speed or is running under high loads, and is closed by the action of the aforementioned valve which is actuated under the action of a valve which is operable in response to rapid increases the suction vacuum suffers as the engine speed is rapidly diminishing.

43375 **Method of manufacturing a catalyst for catalytic purification of exhaust gases.** Siebels, J. (to Volkswagenwerk Aktiengesellschaft). US Patent 4,148,120. 10 Apr 1979. Priority date 16 Jul 1974, German, Federal Republic of (F.R. Germany), 4p.

The invention discloses a catalytic unit for treating gases, particularly exhaust gases of internal combustion engines, comprising a housing, adapted to be connected in an exhaust gas line, and a monolithic carrier body provided with a catalytic agent. The carrier body is mounted within the housing by an intermediate layer arranged in compression between the circumferential surface of the carrier body and the housing. According to the invention, the intermediate layer is so compressed by the surrounding housing that it exerts a pressure on the surface of the carrier body in the range of 20 to 80 N/cm^2.

43376 **Engine exhaust gas purification system.** Katahira, E.; Yamaguchi, S.; Kida, M.; Ishida, Y. (to Nippon Soken, Inc.). US Patent 4,147,030. 3 Apr 1979. Priority date 19 Apr 1976, Japan, 12p.

The invention discloses an engine exhaust gas purification system having an exhaust gas reactor mounted on the engine exhaust pipe, a secondary air supply system having a secondary air supply passage connected to the exhaust pipe upstream of the reactor, and an exhaust gas air-fuel ratio detector mounted on the exhaust pipe to detect air-fuel ratio of exhaust gases in the exhaust pipe. A secondary air supply control valve is provided in the secondary air supply passage and controlled by a valve actuator having a diaphragm to which positive pressure of the secondary air and the engine intake vacuum pressure can be applied. The application of the positive and vacuum pressures to the diaphragm is controlled by solenoid valves which are controlled in accordance with the air-fuel detector output voltage which represents the detected exhaust gas air-fuel ratio, whereby the secondary air supply control valve is controlled such that the secondary air is supplied to the engine exhaust gases at a continuously controlled, variable rate.

43377 **Internal combustion engine with exhaust gas recirculation system.** Tanuma, T.; Harada, M. (to Nissan Motor Co., Ltd.). US Patent 4,147,031. 3 Apr 1979. Priority date 11 May 1976, Japan, 6p.

A part of the exhaust gases from an engine is fed into an intake manifold via an insulated space which is formed between an inner shell defining therein an exhaust gas passage through which the exhaust gases from the engine pass before discharging into the open air, and an outer shell spacedly but substantially covering the inner shell.

43378 **Exhaust gas recirculation system in an internal combustion engine.** Nagano, T. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,147,141. 3 Apr 1979. Priority date 22 Jul 1977, Japan, 4p.

This application discloses an exhaust gas recirculation system in an internal combustion engine. The system is comprise of: (1) an EGR pipe which interconnects an exhaust pipe and an intake pipe of the engine; (2) an EGR valve mounted of the EFR pipe; (3) an EGR cooler mounted on the EGR pipe upstream of said EGR valve; (4) a by-pass pipe arranged parallel to the EGR cooler; (5) a thermosensor which detects the EGR gas temperature; and (6) a selection valve arranged at the connection point of the by-pass pipe to the EGR pipe, the selection valve co-operating with the thermosensor so that when the EGR gas temperature is low, the EGR gas passes through the by-pass pipe.

ALTERNATIVE FUELS

43379 **Manganese containing fuels.** Feldman, D.W.; Sprague, J.W.; Veatch, F. (to Standard Oil Co.). US Patent 4,141,693. 27 Feb 1979. Filed date 18 Dec 1974. 4p.

The invention is gasoline containing an added managenese compound to improve the octane rating of the gasoline and including a small amount of an additive selected from a group consisting of a monocarboxylic acid or its ester, a dicarboxylic acid or its monoester or diester, an alkylamine, phenol, a substituted phenol or mixture thereof.

MATERIALS

43380 (DOE/ET—0086) **EMaCC: FY-1978 topical area report.** (Department of Energy, Washington, DC (USA). Office of Energy Technology). Apr 1979. 242p. Dep. NTIS, PC A11/MF A01.

Materials research and development in the energy program are briefly described. Topics reviewed include joining of materials, elastomers, catalysts and catalytic effect, radiation effects, superconductivity, cement, concrete, and alternate materials. (FS)

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 42377, 42595, 43395, 43401, 43407

43381 (BDX—613-2160(Rev.)) **Electrodeposition process control equipment. Final report.** Lembke, J.R. (Bendix Corp., Kansas City, MO (USA)). Apr 1979. Contract EY-76-C-04-0613. 18p. Dep. NTIS, PC A02/MF A01.

A new x-ray fluorescence analysis system was assembled to perform automatic analysis of element ratios in plated alloys. A level-temperature system was developed to provide integrated control of plating tank temperature, liquid level, and filter pump operation. A second generation electroplating control system was developed which incorporates level temperature control, plating fixture motor control, reference-voltage control, and digital display and recording of plating variables.

43382 (CONF-790437—9) **Low-temperature effects in metals as observed by positron annihilation.** Smedskjaer, L.C.; Fluss, M.J.; Siegel, R.W.; Chason, M.K.; Legnini, D.G. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Recently published experimental positron annihilation data in metals have demonstrated exceptional temperature-dependent behavior in the prevacancy region. However, the magnitude of these effects seems at present to scatter widely among different observers. New lifetime and Doppler-broadening results for Au between 30 and 590°K are presented and compared to results obtained in other laboratories. Doppler-broadening results obtained for Cu in the temperature region 300 to 1310°K demonstrate that some temperature-dependent structure observed in the prevacancy region is related to the thermal history of the sample.

43383 (IS-M—203) **Zone refining of rare earth metals. II.** Fort, D.; Beaudry, B.J.; Jones, D.W.; Gschneidner, K.A. Jr. (Iowa State Univ. of Science and Technology, Ames (USA); Birmingham Univ. (UK)). 1979. Contract W-7405-ENG-82. 6p. (CONF-790641—5). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

In work reported at the 13th Rare Earth Conference, zone melting was shown to move impurities in commercial purity rare earth metals. The interstitial impurities O and N moved in the opposite direction from the zone while metallic impurities moved with the zone. The results of further experiments using Ames Laboratory high purity rare earth metals as starting material are reported. Analyses of a zone melted bar of gadolinium showed that the metallic impurities at the starting end of the bar were the lowest ever observed in gadolinium. Over half of the length of the bar had been purified with respect to O and N. The results obtained on cerium metal by this technique are also given.

43384 (ORNL/BRP—79/2) **Modified 9 Cr-1 Mo steel development program progress report, September 30, 1978.** DiStefano, J.R. (comp.). (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 290p. AT.

The progress made in the development of alloy composition, mechanical properties, thermal stability, and environmental effects on modified 9 Cr-1 Mo steel is reported. Topics reported include material preparation, microstructure, composition, impact test properties, filler metal development, creep and stress rupture tests, and weldability. Low cycle fatigue and testing of type 316 SS is discussed. (FS)

43385 (ORO—5246-3) **Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1978—April 30, 1979.** Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). Apr 1979. Contract EY-76-S-05-5246. 169p. Dep. NTIS, PC A08/MF A01.

Investigations are reported on mechanisms involved with hydrogen metal interactions which control the absorption and desorption processes in intermetallic compounds. (FS)

43386 (RFP—2837) **Carbide precipitation in the heat affected zone of a GTA weld in 21-6-9 stainless steel.** Carr, M.J.; Thorvaldson, W.G. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 14 May 1979. Contract EY-76-C-04-0789. 13p. Dep. NTIS, PC A02/MF A01.

Grain boundary precipitation was observed in a multipass GTA weld in 21-6-9 stainless steel. The precipitate was identified by electron diffraction as $M_{23}C_6$-type carbide. The presence of these carbide particles did not cause intergranular attack in standard corrosion tests.

43387 (RFP—2838) **Abbreviated machining schedule for fabricating beryllium parts free of surface damage.** Beitscher, S.; Capes, J.F.; Leslie, W.W.; Luckow, J.R.; Riegel, R.L. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 18 May 1979. Contract EY-76-C-04-3533. 25p. Dep. NTIS, PC A02/MF A01.

This study was performed to develop a more economical method of machining damage-free beryllium components at Rocky Flats. The present method involves a 9-pass schedule of lathe turning followed by a chemical etch. Prototype beryllium hemispherical shell parts and cylindrical tensile specimens machined to simulate the parts were utilized in this study. The main investigative methods used to evaluate the amount of machining damage were metallography and tensile tests. It was found that damage-free parts could be produced by carefully controlled machining if the number of machining passes was reduced to 4 or even 3, if followed by the standard etching treatment. These findings were made on Select S-65 grade beryllium, and probably apply to other common grades of powder source beryllium but not necessarily to ingot-source beryllium. It is recommended that the 4-pass schedule becomes the standard method to produce damage-free beryllium derived from powder. Significant savings in time, labor, and equipment can be realized by this change in method without decreasing the quality of the product.

43388 (SAND—78-8207) **Palladium sintering: shrinkage kinetics for a sponge powder.** German, R.M.; Ham, V. (Sandia Labs., Livermore, CA (USA)). Apr 1979. Contract EY-76-C-04-0789. 18p. Dep. NTIS, PC A02/MF A01.

Pellets pressed from sponge palladium powder were sintered both isothermally and with constant heating rates using a dilatometer. Computer analysis of the data is used to determine shrinkage and shrinkage rate behavior during the sintering operation. The data are used in conjunction with metallographic examination to correlate the shrinkage phenomena to the change in grain size and pore morphology.

43389 **Unmixed zone formation in austenitic stainless steel weldments.** Baeslack, W.A. III; Lippold, J.C.; Savage, W.F. *Weld. J. (Miami);* **58**: No. 6, 168-176(Jun 1979).

An investigation of the weld interface region in heterogeneous austenitic stainless steel weldments on an 18Cr-8Ni base metal indicates that a well-developed unmixed zone exists along the boundary separating the weld composite region from the partially-melted region. Since the unmixed zone exists as a laminar layer of base metal which has melted and resolidified in situ during the welding process, the average composition of this region is identical to that of the base metal. The duplex austenite-ferrite microstructure of the unmixed zone appears similar morphologically to the microstructure of autogenous 18Cr-8Ni weldments. Constant extension rate stress-corrosion cracking tests were performed on transverse-welded tensile specimens in room and elevated temperature chloride-containing solutions which readily produce stress-corrosion cracking in 18Cr-8Ni base materials. Test results indicate that the duplex unmixed zone can be preferentially susceptible to corrosion-induced attack. Preferential environmentally-induced cracking in the unmixed zone of both Type 310/Type 304L and Type 312/Type 304L weldments is particularly severe in low pH, room temperature solutions; it involves the combined and interrelated occurrence of stress-assisted ferrite dissolution and stress-corrosion cracking in the austenite. Designing a wholly austenitic weldment by simply using a high-nickel filler metal is not possible. It could lead to catastrophic results if such weldments are employed under conditions conducive to stress-corrosion cracking.

43390 **Solubility and diffusivity of fluorine in solid copper from electrochemical measurements.** Reddy, S.N.S.; Rapp, R.A. (Ohio State Univ., Columbus). *Metall. Trans., B;* **9B**: No. 4, 559-565(Dec 1978).

The solubility and diffusivity of fluorine in solid copper were determined electrochemically using the double solid-state cell Ni/NiF_2/CaF_2/Cu/CaF_2/Ni + NiF_2. In the temperature range 757 to 920°C, the diffusivity of fluorine in solid copper was found to be D/sub f/ (cm^2/s) = 9.32 x 10^{-3} exp (-98,910 J/mole/RT). The results obtained for the dissolution of fluorine as atoms in solid copper showed large scatter. However, the equilibrium dissolution of florine follows Sieverts' law. Above the melting point (770°C) of CuF_2, the mean solubility of fluorine in solid copper, for the equilibrium Cu(s) + CuF_2(l), follows the relationship N/sub F//sup s/ (atom fraction) = 0.98 exp (-79,500 J/mole/RT).

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 43384, 43388, 43409, 43410, 43428, 44055

43391 (CONF-790437—6) **Positron annihilation measurement of the vacancy formation enthalpy in copper.** Fluss, M.J.; Smedskjaer, L.C.; Siegel, R.W.; Legnini, D.G.; Chason, M.K. (Argonne National

Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Doppler-broadening and lifetime data obtained for Cu in the temperature region ~ 25 to 1040°C are presented. The experiment utilized a new source-implantation technique. The value of the deduced vacancy formation enthalpy is 1.31 +- 0.05 eV. Since the Doppler-broadening data were the primary source for the determination of the vacancy formation enthalpy, the analysis of these data is discussed. The suitability of introducing divacancies into the analysis is also considered. It is concluded that the measured formation enthalpy is that for monovacancies.

43392 (DOE/ER/01023—2) **Study of mechanisms of hydrogen diffusion in separation devices. Second annual report, April 1978—March 1979.** Lee, M.H. (Georgia Univ., Athens (USA). Dept. of Physics). 5 Apr 1979. Contract AS09-77ER01023. 11p. Dep. NTIS, PC A02/MF A01.

The diffusion of light gases (e.g., hydrogen) in palladium-type transition metals is selective. Membranes made of these metals can potentially be very useful as separation devices in nuclear fusion reactors. The nature of light-gas diffusion in transition metals is very poorly understood. The diffusion and other transport properties are known to be governed by quantum many-body mechanisms. To realize possibly rich applications of this problem, a detailed study of the transport mechanisms and the physics of a metal hydride system is initiated.

43393 **Plutonium-platinum Pu_2Pt.** Cromer, D.T. (Los Alamos Scientific Lab., NM (USA)). *Acta Crystallogr., Sect. B;* **34**: No. 8, 2608-2610(15 Aug 1978).

Pu_2Pt is orthorhombic, with space group Pnma, Z = 4, a = 7.046 (3), b = 4.707 (2), c = 8.865 (4) A, rhosub(c) = 15.20 g cm^{-3}, μ = 1115 cm^{-1}, lambda = 0.70930 A. This structure belongs to the C23, $PbCl_2$ type.

43394 (LBL—8975, pp 35-36) **Surface characterization of catalytically active metal, alloy, and compound films.** Vook, R.W. (Syracuse Univ., NY). Feb 1979.

In Heterogeneous catalysis research meeting.

43395 (ORNL—5537) **Thermodynamics of precipitation systems.** Williams, R.O. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

The particular combination of features that are required for a binary system to show useful precipitation hardening is examined. Because this combination is relatively rare, we are not optimistic that many useful binary systems remain to be discovered. When one goes to higher order systems one has much greater opportunities for developing useful systems because of the increased degrees of freedom. The difficulty of understanding what is happening is also correspondingly greater, but if it is possible to properly represent the thermodynamics of the system, then this problem can be resolved. Considerable potential is believed to exist for the development of new alloys containing three or more components.

43396 **Singularities of magnetic phase transitions in heavy rare-earth metals.** Savchenko, M.A.; Stefanovich, A.V. (Moscow Institute of Radio Engineering, Electronics, and Automation). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 311-313(20 Sep 1978).

The magnetic phase transitions in the heavy rare-earth metal thullium (Tm) were investigated on the basis of the fluctuation theory of phase transitions. It is shown that N+1 (N<6) stationary states are produced in thullium when it goes from the paramagnetic region into the disordered state, and only in the lowest order state does the crystal have a nonzero spontaneous magnetic moment. The phase transition to the ground state of the system turns out to be of second order, and all others are fluctuation phase transitions of first order.

43397 **Deuterium trapping in irradiated 316 stainless steel.** Wilson, K.L.; Baskes, M.I. (Sandia Labs., Livermore, CA (USA)). *J. Nucl. Mater.;* **76**: No. 77, 91-297(Sep-Oct 1978).

From 3. international conference on plasma surface interactions in controlled fusion devices; Abingdon, UK (3 - 7 Apr 1978).

Linear ramp thermal desorption measurements were conducted on 316 stainless steel samples implanted at 296 K with 1-10 keV D^+ to fluences of 10^{17} D^+/cm^2. Samples were held 1-100 h at 296 K prior to desorbing. The desorption data were shown to arise from two dominant mechanisms: bulk migration of mobile deuterium atoms with approximately 0.6 eV migration energy, and release from near surface traps with a net detrapping energy of approximately 0.9 eV. After 10 keV D^+ bombardment, more complex desorption spectra were observed. Samples pre-damaged with 300 keV $^3He^+$ exhibited a significant increase in the deuterium trapping compared to samples without pre-bombardment. Based on the data and modelling, estimates of tritium retention in TFTR were made.

43398 **Loss of coherency in spinodally decomposed Cu—Ni—Fe alloys.** Livak, R.J.; Thomas, G. (Univ. of California, Berkeley). *Acta Metall.;* **22**: 589-599(May 1974).

Coarsening of the spinodal microstructure in copper—nickel—iron alloys has been studied in detail using transmission electron microscopy. Loss of coherency in this lamellar microstructure occurs by the capture of slip dislocations and subsequent multiplication at the interphase interfaces. Based on the observations, it is proposed that the multiplication process providing the misfit-accommodating dislocation loops proceeds by the spiraling of the captured dislocations around the platelets by climb, similarly to the formation of helical dislocations. Because the Burgers vector of the captured dislocation is inclined at 45° to the [100] interface, diffusion controlled rotation of the initial [100] coherent interface toward the [110] plane containing b occurs in order to lower the interfacial energy. This rotation of the semi-coherent interfaces results in a change of the initial platelet morphology to a microstructure containing rod-shaped and more equiaxed particles.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 42499, 42505, 42651, 42882, 42951, 42957, 43382, 43384

43399 (EPRI-NP—1023) **Fracture and fatigue properties of 1Cr—Mo—V bainitic turbine rotor steels. Technical report.** Roman, I.; Rau, C.A. Jr.; Tetelman, A.S.; Ono, K. (Failure Analysis Associates, Palo Alto, CA (USA)). Mar 1979. 268p. Dep. NTIS, PC A12/MF A01.

The deformation, fracture and fatigue properties of 1Cr—Mo—V turbine rotor steel have been evaluated for a wide range of loading conditions and metallurgical structures controlled by melting and heat treatment practice. The mechanical property differences and corresponding metallurgical differences between older, air-melted steels and newer heats that are vacuum degassed were determined. Current vacuum degassing practice improves the tensile ductility, fracture toughness, and fatigue initiation resistance compared to air-melted material by reducing both the size and number of MnS inclusions and the bainite packet size. The yield strength, ultimate strength, and fatigue crack propagation rate are insensitive to these microstructural differences because they are controlled by dislocation substructure. The effects of prior fatique cycling on fracture toughness have been measured, and a model has been developed to predict the effect for various materials and loading conditions. Irrespective of the fracture mode, materials which soften under strain cycling, like this rotor steel, show a toughness which increases with number and magnitude of prior fatigue cycling.

43400 (N—79-11178) **Deformation and annealing study of nicraly.** Ebert, L.J.; Trela, D.M. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Metallurgy and Materials Science). Oct 1978. Contract NGR-36-003-094. 76p. NTIS PC A05/MF A01.

The elevated temperature properties (tensile and creep) of NiCrAlY, a nickel base alloy containing nominally 16% chromium, 4% aluminum, and 2 to 3% yttria (Y2O3) were evaluated and the optimal combination of thermomechanical treatments for maximum creep resistance was determined. Stored strain energy in as-extruded bars (14:1 extrusion ratio) permitted the development of a large grain size in the material when it was annealed at the maximum safe temperature 2450 F (1343 C). With a one-hour anneal at this temperature, the relatively fine grain size of the as-extruded material was changed to one in which the average grain diameter approached 1 mm, and the aspect ratio was about 10. The material was capable of being cold worked (by rolling) in amounts greater than 30% reduction in area. When the cold worked material was given a relaxation treatment, consisting of heating one hour at 1600 F(871 C), and then a high temperature anneal at 2450 F (1343 C) for one hour, both the high temperature strength and the high temperature creep resistance of the material was further enhanced.

43401 (ORNL/TM—6781) **Use of ultimate tensile strength to estimate the creep—rupture behavior of austenitic weld metals and castings.** Sikka, V.K.; McEnerney, J.W. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 62p. AT.

Nuclear and fossil power plants, coal conversion systems, and chemical plants constructed of types 304 and 316 stainless steel generally contain welds deposited with type 308, 317, or 16-8-2 filler metal. Autogenous welds (without filler metal) may be used. Prospects for estimating weld creep data with significant success by use of knowledge of weld metal elevated-temperature tensile properties are described. Previously developed base metal rupture time and minimum creep rate empirical models containing an elevated-temperature ultimate tensile strength are extended to the weld metal data. The base—metal models for type 304 stainless steel to type 308

weld metal and models for type 316 to type 316 or 16-8-2 weld metal are applied. Data were analyzed for both as-welded and heat-treated weld metals and weldments, centrifugally cast pipes, and the riser portions of static castings of types 316L and 316 stainless steel. The weldments investigated were made by the submerged-arc, shielded metal-arc, and gas tungsten-arc processes. The data on castings were analyzed both as cast and after sigma heat-treatment. Creep-rupture tests extending over rupture times ranging to 10,000 h and temperatures from 482 to 649°C were considered. Elevated-temperature ultimate tensile strength can be used as a possible index for estimating the creep—rupture time and minimum creep rate properties of austenitic welds and castings. Rupture times were predicted more accurately than the minimum creep rates. Use of elevated-temperature ultimate tensile strength is suggested to check if the fabrication procedures during welding are followed and if the weldment meets the specified creep properties.

43402 (ORNL/TM—6822) **Creep behavior of Hastelloy X, 2 1/4 Cr—1 Mo steel, and other alloys in simulated HTGR helium.** McCoy, H.E. Jr. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 58p. Dep. NTIS, PC A04/MF A01.

Creep tests on several materials both in environments of air and in helium containing small amounts of H_2, CH_4, CO, and H_2O are reported. Tests have been run on Hastelloy X at 650 to 870°C for times to 20,000 h, and although it does carburize in helium, its creep properties are very similar in both environments. Tests have been run on 2 1/4 Cr—1 Mo steel at 482 to 650°C for times to 20,000 h, and its creep strength is less in helium than in air, likely because of the decarburization that occurs in helium. Limited creep tests have been run on 9 Cr—1 Mo steel, alloy 800H, Hastelloy S, and alloy 617. The results show no large environmental creep effects but are insufficient to conclude that such effects do not exist. A test sample of Ni-7% Cr-12% Mo-4% Fe-2% Ti completely resisted carburization under conditions where Hastelloy X increased in carbon content from 0.0993 to 0.436%. Most of the creep tests described in this report are continuing. Samples of Hastelloy X and alloy 617 for subsequent testing are aging; one set has accumulated 17,000 h in air, and one set has accumulated 7000 h in helium.

43403 (SAND—79-0193C) **Dependence of fracture toughness of molybdenum laser welds on dendritic spacing and in situ titanium additions.** Jellison, J.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 12p. (CONF-790518—6). Dep. NTIS, PC A02/MF A01.

From 10. US/UK symposium on neutron generators; Albuquerque, NM, USA (21 May 1979).

The fracture toughness of molybdenum welds has been improved by in situ gettering of oxygen by means of physically deposited titanium. The addition of titanium suppressed brittle intergranular fracture. Pulsed laser welds (both Nd:YAG and CO_2) exhibited superior toughness to that of continuous wave CO_2 laser welds. Also, welds of vacuum arc remelted grades were tougher than those of sintered molybdenum. However, weld toughness could not be correlated with either oxygen or carbon content.

43404 (UCRL—82308) **Experimental investigation of crack path directional stability.** Streit, R.; Finnie, I. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Berkeley (USA)). Apr 1979. Contract W-7405-ENG-48. 33p. (CONF-790503—3). Dep. NTIS, PC A03/MF A01.

From Spring meeting of society for experimental stress analysis; San Francisco, CA, USA (20 May 1979).

Using the criterion that a crack will extend perpendicular to the maximum circumferential stress, it is shown that the directional stability of crack growth is governed by the location of micro-crack initiation ahead of the crack tip. At distances greater than a geometrical radius r_0 the maximum value of σ/sub θ/ deviates from the position of symmetry. Thus, if it is assumed that the physical processes involved in fracture lead to crack initiation at a distance r/sub c/ ahead of the crack tip, the criterion for directional stability is $r_0 >$ r/sub c/. Experimental and theoretical values of r_0 verify that as r_0 becomes small, the crack's directional stability deteriorates.

43405 **Study of intergranular cavity growth in Ag + 0.1% MgO at elevated temperatures.** Nieh, T.G.; Nix, W.D. (Stanford Univ., CA). *Acta Metall.;* **27**: No. 6, 1097-1106(Jun 1979).

In a previous study by Goods and Nix, it was shown that implanted grain boundary cavities in Ag grow by a process controlled by surface self diffusion. Accordingly, any changes in the strength of the adjoining grains would not be expected to affect the rate of cavity growth. In the present work, grain boundary cavities were implanted in Ag + 0.1% MgO and their growth kinetics were studied under creep conditions. We show that the fine dispersion of MgO particles present in this material greatly strengthens the matrix and reduces the overall creep rate, as expected, but leaves the rate of cavity growth unchanged. It is concluded that the contributions to cavity growth by plastic flow are negligible and that the mechanisms of cavity growth in Ag and Ag + 0.1% MgO are the same. A model developed originally by Chuang and Rice accurately describes the kinetics of cavity growth in these materials.

43406 **Note on effects of hydrogen on anisotropic elastic properties of bcc Ti—alloys.** Ahlberg, L.A. (Rockwell International Science Center, Thousand Oaks, CA); Buck, O.; Paton, N.E.; Fisher, E.S. *Scr. Metall.;* **13**: No. 5, 359-360(May 1979).

Corrections to a recently published paper on the effects of H on the elastic properties of a Ti—40V alloy are made.

43407 **Ductile ordered alloys.** Krause, C. *Oak Ridge Natl. Lab. Rev.;* **12**: No. 1, 10-16(Win 1979).

The development and testing of ductile ordered alloys for fast breeder reactors, HTGR type reactors, space electric power systems and fusion devices are reviewed. (FS)

43408 **COD and R-curve analysis of wide plate tests on tankage steel.** Metz, P.O.; Sarno, D.A. (Armco Steel Research and Tech., Middletown, OH). pp 63-95 of Fracture toughness of heavy-wall welded tankage steel. Ciuffreda, A.R. (ed.). New York, NY; American Society of Mechanical Engineers (1977).

From ASME energy technology conference on composites in pressure vessels and piping; Houston, TX, USA (18 Sep 1977).

Wide plate test results indicate that, for the flaw sizes studied, Charpy V-notched toughness criteria for welded 1-3/4 in. (45 mm) A537 Class 1 tankage steel and deposited weld metal can sustain strains up to four times the yield strain. In addition, worst case wide plate tests results indicated a leak before break condition for API 650 Appendix G tanks at maximum allowable design stresses. These conclusions were analyzed with both Crack Growth Resistance (R-curve) and Crack Opening Displacement (COD) techniques. The R-curve analysis predicted that fracture would not occur before net section yielding was attained. The COD analysis provided more conservative conclusions in that the allowance for residual stress had to be significantly below yield stress levels. 13 references.

43409 **Effect of austenitizing temperature on the microstructure and mechanical properties of As-quenched 4340 steel.** Lai, G.Y.; Wood, W.E.; Clark, R.A.; Zackay, V.F.; Parker, E.R. (Univ. of California, Berkeley). *Metall. Trans.;* **5**: 1663-1670(Jul 1974).

The effect of austenitizing temperature on both the plane strain fracture toughness, K/sub Ic/, and the microstructure of AISI 4340 was studied. Austenitizing temperatures of 870 and 1200°C were employed. All specimens austenitized at 1200°C were furnace cooled from the higher austenitizing temperature and then oil quenched from 870°C. Transmission electron microscopy revealed an apparent large increase in the amount of retained austenite present in the specimens austenitized at the higher temperature. Austenitizing at 870°C resulted in virtually no retained austenite; only minor amounts were found sparsely scattered in those areas examined. A considerably altered microstructure was observed in specimens austenitized at 1200°C. Fairly continuous 100 to 200 A thick films of retained austenite were observed between the martensite laths throughout most of the area examined. Additionally, specimens austenitized at 870°C contained twinned martensite plates while those austenitized at 1200°C showed no twinning. Plane strain fracture toughness measurements exhibited an approximate 80 pct increase in toughness for specimens austenitized at 1200°C compared to those austenitized at 870°C. The yield strength was unaffected by austenitizing temperature. The possible role of retained austenite and the elimination of twinned martensite in the enhancement of the fracture toughness of those specimens austenitized at the higher temperature will be discussed.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 42608, 43385, 43518, 44043, 44045, 44054, 44057, 44159, 44161, 44167, 44168

43410 (BNL—26132) **Hydrogen diffusion and trapping in bcc and fcc metals.** Richter, D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 19p. Dep. NTIS, PC A02/MF A01.

The fundamental aspects of the metal—hydrogen systems are described. The large number of anomalous properties are the reason for continuous scientific effort. The time scale of hydrogen motion is extremely short. The characteristic frequencies of the localized modes of hydrogen in Ta, Nb, or V are in the order of 10^{-14} sec (energies between 0.1 to 0.2 eV); the jump frequencies for H-diffusion at elevated temperatures in those systems are between 10^{+12} to 10^{+13} sec^{-1}. They are comparable with the correlation times for diffusion in liquids and more than ten orders of magnitude larger than the jump times for nitrogen in Nb. Out of the large number of experimental data this paper will survey only some recent results on representative fcc and bcc metals for dilute H solutions. The nature of the elementary step in H-diffusion is described. Here the temperature and isotope dependence of the H-diffusion coefficient gives hints to the mechanism involved. The experimental results are dis-

cussed in terms of semiclassical and quantum mechanical diffusion theories.

43411 (DOE/ET—0095, pp 41-44) **Graphite degassing.** Gray, W.J. (Battelle-Pacific Northwest Lab., Richland, WA). May 1979.

In Special purpose materials. Annual progress report.

The objective is to measure degassing rates, not merely gas content, of graphite and determine what pretreatment, if any, can be applied to make the rates acceptably low for fusion applications. Equipment based on the pressure-rise method of measuring degassing rates of graphite has been assembled. Degassing rates less than 1.3 x 10^{-12}Pa-m^3/sec-g (10^{-11}Torr-liters/sec-g) at 1.3 x 10^{-4}Pa (10^{-6}Torr) and 1500°C have been measured for graphite previously degassed at 2000°C. These rates are comparable to well-degassed stainless steel at elevated temperatures. Methods of degassing the graphite to achieve these low rates in fusion applications are being studied.

43412 (IS-M—210) **Low temperature heat capacity studies on hydrogen absorbing intermetallic compounds.** Takeshita, T.; Dublon, G.; McMasters, O.D.; Gschneidner, K.A. Jr. (Iowa State Univ. of Science and Technology, Ames (USA)). 1979. Contract W-7405-ENG-82. 5p. (CONF-790641—4). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

Low temperature heat capacities of some ternary Hauke compounds [ThNi$_5$ - /sub x/Al/sub x/(x = 0 to 3), NYi$_5$ - /sub x/Al/sub x/(x = 0 to 1.5) and LaNi$_5$ - /sub x/Cu/sub x/(x = 0 to 5)] were studied. The electronic specific heat constants of these compounds decrease as Ni is substituted with Al or Cu. The Debye temperatures show some variations but not in a systematic manner for the aluminum substitution. In the aluminum substituted ternaries, there is no correlation between the hydrogen absorption capacity with the electronic specific constant and the Debye temperature except for ThNi$_2$Al$_3$. In the pseudo-binary system, LaNi$_5$ - /sub x/Cu/sub x/, the stability of the metal hydride may be related to the rigidity of the metal lattice, i.e. softer the metal lattice the more stable the metal hydride. This is in agreement with our previous observations.

43413 **Effect of chemical environment on magnitude of x-ray absorption resonance at L/sub I/II edges. Studies on metallic elements, compounds, and catalysts.** Lytle, F.W.; Wei, P.S.P.; Greegor, R.B.; Via, G.H.; Sinfelt, J.H. (The Boeing Co., Seattle, Washington 98124). *J. Chem. Phys.;* **70**: No. 11, 4849-4855(1 Jun 1979).

We report spectra isolating the L/sub I/II x-ray absorption threshold resonance of the elements iridium, platinum, and gold in the pure metallic state and in a variety of compounds. When normalized spectra obtained on the metals are subtracted from those obtained on the compounds, the resulting difference spectra are related to differences in the electronic structure of the absorber atom in the two types of environment. The change in area of a threshold resonance line obtained from such a difference spectrum can be related to the ionicity of the bonds of the absorber atom in its compounds. Measurements on supported platinum and iridium catalysts provide information on electronic changes in the metal due to the small size of the metal clusters or to interaction with the support material. Information on electronic changes due to interaction of the catalysts with gas molecules may also be obtained.

43414 **NMR investigation of the diffusion and conduction properties of the semiconductor tellurium. I. Electronic properties.** Selbach, H.; Kanert, O.; Wolf, D. (Physikalisches Institut, Universitaet Dortmund, 46 Dortmund 50, West Germany). *Phys. Rev., B: Condens. Matter;* **19**: No. 9, 4435-4443(1 May 1979).

The Knight shift and spin-lattice relaxation time of ^{125}Te in tellurium single crystals have been measured between room temperature and the melting point (724 K) using pulsed-NMR methods. Over the entire temperature range, the temperature dependence of the Knight shift is found to be determined completely by the intrinsic conductivity associated with thermally created conduction electrons in the conduction band, and the band-gap energy is determined. The spin-lattice relaxation time shows different temperature variations in two different regions: below 420 K ("low-temperature region"), spin-lattice relaxation is due to the conduction electrons (thus yielding information on the gap energy), while above 420 K ("high-temperature region") the relaxation process is due to the self-diffusion of Te atoms. Our Knight-shift results are found to agree quantitatively with a modified Knight-Korringa relation valid for semiconductors, which was originally derived by Bloembergen and which is reconsidered in the theoretical part of this article. The electronic contribution to spin-lattice relaxation is analyzed in terms of Hebel and Slichter's single spin-temperature theory as applied to semiconductors. The same gap energy, E/sub g/ < 0.30 eV, is found from both our Knight-shift and spin-lattice relaxation data. The self-diffusion properties of tellurium as extracted from our high-temperature relaxation studies will be the subject of a subsequent article.

43415 **ac losses of bronze-processed (Nb/sub 1-x/Zr/sub x/)$_3$Sn between 5 and 16 K.** Bussiere, J.F.; Kovachev, V.T. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.;* **50**: No. 5, 3510-3513(May 1979).

ac losses of bronze-processed Nb$_3$Sn tapes were measured between 5 and 16 K. Additions of up to 5% Zr to the Nb substrate were found to cause only a slight increase in loss. However, because of the increased T/sub c/ of the NbZr substrate as compared to pure Nb, such additions appear advantageous in some ac applications. The lowest losses were obtained for an anodized sample of (Nb—1% Zr)$_3$Sn (e.g., 11 μW/cm^2 at 500 rms A/cm and 12 K).

43416 **Hysteretic losses of a type-II superconductor in parallel ac and dc magnetic fields of comparable magnitude.** Thompson, J.D.; Maley, M.P.; Clem, J.R. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Appl. Phys.;* **50**: No. 5, 3531-3541(May 1979).

Measurements of 50-Hz hysteretic losses in Nb$_3$Ge material have been performed in the presence of a dc-bias magnetic field. The measurements were made by an electrical technique with both the ac and dc magnetic fields parallel to the axis of long Nb$_3$Ge-coated cylinders. With a fixed ac amplitude h$_0$, the losses are observed to decrease as the dc field H$_0$ is raised from zero, to pass through a minimum, and then to increase monotonically. The position of the minimum is observed to occur when H$_0$<h$_0$-H/sub s/, where H/sub s/ is the field at which initial entry of flux into the sample is observed. Minimum depths which reach 30% of the zero-bias loss are found for samples in which H/sub s/ is large (> or =900 Oe). This "minimum" effect and other aspects of ac losses in the presence of a dc-bias field are explained qualitatively by a critical-state model that takes account of the magnetic field dependences of the critical current density J/sub c/(B) and the surface barrier ΔH (B). The experimental results are also compared with the results of calculations based upon a recent theoretical treatment that allows the use of independently determined functional forms for J/sub c/(B), ΔH (B), and H (B). Qualitative agreement is obtained between theory and experiment.

43417 **Concentration dependence of Cd diffusivity enhancement in dilute Pb—Cd alloys.** Carlson, P.T.; Padgett, R.A. Jr. (Oak Ridge National Lab., TN). *Scr. Metall.;* **13**: No. 5, 355-358(May 1979).

Solute diffusivity enhancement techniques were used to provide experimental evidence for the existence of interstitial-substitutional solute pairs. Diffusion of Cd in Pb—Cd alloys is thought to represent the substitutional extreme of the dissociative equilibrium.

43418 **Low-energy interband absorption in bcc Fe and hcp Co.** Weaver, J.H.; Colavita, E.; Lynch, D.W.; Rosei, R. (Synchrotron Radiation Center, University of Wisconsin-Madison, Stoughton, Wisconsin 53589). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 3850-3856(15 Apr 1979).

We have examined the electronic structure of bcc Fe and single-crystal hcp Co by using optical absorptivity and thermoreflectance techniques for 0.2 < or = hν < or = 5 eV. The optical conductivities σ were calculated by Kramers-Kronig analyses. A prominent structure was observed in σ for Fe at 2.37 eV and a shoulder was observed near 0.8 eV; the latter structure was the dominant feature in the thermoreflectance spectrum. These were discussed in terms of minority-spin band interband absorption and spin-flip interband transitions. The anisotropic optical conductivities of hcp Co were discussed in terms of recent energy-band calculations.

43419 **Diffusion of titanium and niobium in bcc Ti-Nb alloys.** Pontau, A.E.; Lazarus, D. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 4027-4037(15 Apr 1979).

The diffusion coefficients for titanium and niobium radioactive tracers were simultaneously measured in Ti, Ti@sub 94.6@Nb@sub 5.4@, Ti@sub 80.4@Nb@sub 19.6@, and Ti@sub 64.3@Nb@sub 35.7@ over the temperature range from 950 °C to 1511 °C using standard lathe-sectioning techniques. The samples were initially heat treated by annealing above the α-β phase-transition temperature and then either cooling slowly to room-temperature or quenching. The room-temperature crystal morphology was then examined using x-ray diffraction. Alloy concentrations were chosen both to suppress the β-α transition and to obtain the metastable ω phase. The data may be described by Ti: D@sub Ti@ < 4.54 x 10^{-4}e@sup -31ts300/RT@ cm^2/sec; D@sub Nb@ < 2.91 x 10^{-4}e@sup -31ts030/RT@ cm^2/sec; Ti@sub 94.6@Nb@sub 5.4@: D@sub Ti@ < 1.27 x 10^{-3} e@sup -35ts610/RT@ cm^{2}sec; D@sub Nb@ < 1.79 x 10^{-3}e@sup -38ts220/RT@ cm^{2}sec; Ti@sub 80.4@Nb@sub 19.6@: D@sub Ti@ < 3.15 x 10^{-3} e@sup -41ts960/RT@ cm^2/sec; D@sub Nb@ < 1.18 x 10^{-2}e@sup -47ts330/RT@ cm^2/sec; Ti@sub 64.3@Nb@sub 35.7@: D@sub Ti@ < 2.51 x 10^{-1} e@sup -59ts020/RT@ cm^2/sec; D@sub Nb@ < 2.98 x 10^{-1}e@sup -61ts730/RT@ cm^2/sec. The hypothesized enhancement of diffusion

by ω-phase fluctuations or effects of the hcp to bcc phase transformation cannot be ruled out by this work, but are certainly not supported directly by the present results.

43420 Heats of chemisorption of O_2, H_2, CO, CO_2, and N_2 on polycrystalline and single crystal transition metal surfaces. Toyoshima, I.; Somorjai, G.A. (Univ. of California, Berkeley). *Catal. Rev. - Sci. Eng.;* **19**: No. 1, 105-159(1979).

Much of the available heat of adsorption data are reviewed for several small molecules, (H_2, O_2, CO, CO_2, and N_2) adsorbed on transition metal surfaces. The effect of the atomic surface structure on the heats of chemisorption of these gas molecules as revealed by studies of chemisorption on various crystal planes was reviewed. The heat of adsorption measurements were made by calorimetry thermal desorption, ellipsometry and the electronic work function of the metal. The heats of chemisorption of these small molecules are the largest for the early transition metal surfaces, decreasing toward the right to reach the lowest values for Cu, Ag, and Au. The data obtained for the highest binding energy adsorption states on single crystal surfaces also follow this trend within the uncertainty of the experiments. The data reported here should be useful to predict the surface composition when two or more molecules compete for the same adsorption sites under equilibrium conditions. The heats of chemisorption can also be used to predict when dissociation of the adsorbed molecules is likely to take place. Dissociation on the surface may be the precursor of the various surface reactions. 17 figures, 5 tables.

43421 Investigation of the superconducting state of V_3Ga by the μ^+ method. Grebinchik, V.G.; Gurevich, I.I.; Zhukov, V.A.; Lazarev, A.B.; Levina, L.A.; Maiorov, V.N.; Mynych, A.P.; Mel'nikov, E.V.; Nikol'skii, B.A.; Roganov, V.S.; Selivanov, V.I.; Suetin, V.A. (I. V. Kurchatov Institute of Atomic Energy). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 367-370(20 Sep 1978).

It is shown, with V_3Ga as an example, that it is possible to measure by the μ^+-meson method the relative volume of the superconducting and nonsuperconducting phases of a type-II superconductor as a function of the external magnetic field. The magnetic field B/sub c/1 is estimated for the alloy V_3Ga.

43422 Electrical resistance of high-purity vanadium: critical superconducting temperature and anomalies in the temperature dependence. Azhazha, V.M. *Fiz. Met. Metalloved.;* **41**: No. 6, 1188-1195(Jun 1976). (In Russian).

The production of very high-purity V with a low residual electrical resistance is described. High purity is achieved by a combination of electron-beam melting and electric transport, and the residual resistance is 1/1520 times that at ordinary temp. Analysis of resistance measurements on six such samples at 1.8-300°K gives the critical superconducting temp. as 5.6°K. An anomalous change in the temp. coeff. of resistance occurs at 183°K. In contrast to many transition metals the electrical resistance of V contains a term proportional to T^4. The anomalous behavior increases with increasing purity of the V. 20 references.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 42193, 42411, 42497, 42832, 42921, 42926, 43386, 43389, 43637

43423 Experience with steam generator tubes in water-cooled nuclear power reactors. Tatone, O.S.; Pathania, R.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Nucl. Eng. Int.;* 35-39(Apr 1978).

Steam generator tube failures have been a persistent problem at many watercooled nuclear power stations. These include pressurized water reactors, pressurized heavy water reactors and boiling water reactors with secondary steam generators. Although the number of leaking tubes may be small, even a single leak can force a shutdown. And for a 1000 MWe reactor, the cost of replacement power could amount to $250,000 per day.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 44151, 44154, 44155, 44156, 44165

43424 (CONF-790125—50) **Tensile properties of type 316 stainless steel irradiated in a simulated fusion reactor environment.** Grossbeck, M.L.; Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Tensile and fracture properties of type 316 stainless steel in the annealed and 20% cold-worked conditions were investigated to neutron fluences producing 16 dpa and 1000 at. ppM He resulting from irradiation in the High Flux Isotope Reactor. Tensile elongations remained above 6% at 350 and 450°C and 4% at 575°C. Fracture behavior has been examined in the 20% cold-worked material. At 350°C the fracture mode is unchanged by irradiation and is characterized by ductile tearing. At 450°C irradiation causes the fracture mode to change from ductile tearing to crystallographic fracture which may occur along the slip bands introduced by the cold working. At 575°C the fracture is changed from ductile transgranular to intergranular. The tensile properties observed are believed to be adequate for fusion reactor service within the values of damage parameters investigated.

43425 (CONF-790125—51) **Swelling with inhomogeneous point defect production: a cascade diffusion theory.** Mansur, L.K.; Coghlan, W.A.; Brailsford, A.D. (Oak Ridge National Lab., TN (USA); Ford Motor Co., Dearborn, MI (USA)). 1979. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

A theoretical method is described for evaluating the effects of spatially and temporally discrete production in collision cascades on point defect concentrations and swelling in materials during irradiation. The concentrations of vacancies and interstitials at a point which result from their diffusion from all cascades in the material are calculated. Large fluctuations occur with time in the vacancy concentration. The interstitial concentration is nearly always zero except for extremely large spikes of very short duration, corresponding to the occurrence of a cascade anywhere within the sphere beyond which all generated defects are absorbed by sinks before reaching the reference point. The growth rate of a void in this cascade diffusion theory is compared to that given by the more approximate rate theory. The difference is small but increases rapidly at high temperature. Implications of this work for void nucleation, irradiation creep, and analysis of pulsed irradiations are mentioned.

43426 (CONF-790125—52) **Advances in the theory of radiation effects in metals and alloys.** Mansur, L.K.; Yoo, M.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Recent advances in the theory of swelling are reviewed. These include the development of a cascade diffusion theory to treat quantitatively the local fluctuations in point defect concentrations, the incorporation of mobile helium into the rate theory, and the spatial variation in swelling during charged particle bombardment.

43427 (CONF-790125—53) **Ductility in bending of molybdenum alloys irradiated between 425 and 1000°C.** Cox, B.L.; Wiffen, F.W. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Molybdenum and the alloys Mo—0.5% Ti and TZM were irradiated at four temperatures between 425 and 1000°C, to a displacement level of 11 dpa at a fluence of 2.5×10^{26} n m $^{-2}$ (> 0.1 MeV). Vacuum bend tests at elevated temperatures showed the ductile-to-brittle transition temperature (DBTT) to be above room temperature for all irradiation temperatures. Irradiation at 585°C produced the highest DBTT, 550 to 700°C. Differences among the three materials were minor.

43428 (COO—3158-70) **Direct observation of the vacancy structure of depleted zones in tungsten ion irradiated at 10°K.** Wei, C.Y.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Dec 1978. Contract EY-76-S-02-3158. 13p. Dep. NTIS, PC A02/MF A01.

The structure of depleted zones (DZs) created by the in-situ irradiation of tungsten specimens, at 10°K, with 30 keV W^+, Mo^+ or Cr^+ ions has been studied by field-ion microscopy. As the mass of the 30 keV ion was decreased the following observations were made: (1) the spatial extent of the DZs increased; (2) the vacancy concentration within the DZs decreased; (3) the fraction of isolated monovacancies increased; and (4) subcascades formed within the DZs.

43429 (DOE/ET—0095, pp 35-36) **Graphite radiation damage at temperatures up to 1900°C.** Gray, W.J. (Battelle-Pacific Northwest Lab., Richland, WA). May 1979.

In Special purpose materials. Annual progress report.

The objective is to evaluate radiation damage effects in bulk graphites and other carbonaceous materials at temperatures up to 2000°C. Goals of the initial testing program have been developed. A problem of graphite reacting with its tungsten heater element has been encountered and a method of resolving the problem is being tested.

43430 (DOE/ET—0095, pp 37-39) **Relative radiation damage for graphite at neutron energies up to 15 MeV.** Gray, W.J.; Morgan, W.C. (Battelle-Pacific Northwest Lab., Richland, WA). May 1979.

In Special purpose materials. Annual progress report.

The objective was to experimentally determine the relative damage produced by neutrons of different energies so that graphite performance in fusion reactor applications can be more confidently projected on the basis of tests conducted in fission reactor irradiations. Relative changes in the basal-plane elastic shear modulus of Highly Oriented Pyrolytic Graphite (HOPG) samples irradiated in three different neutron sources show that the damage produced by high energy neutrons is greater than predicted by previous models, and that graphite lifetimes will, therefore, be shorter than expected.

43431 (DOE/ET—0095, pp 101-112) **Radiation behavior of superconductors.** Scanlan, R.M.; Raymond, E.L. (Lawrence Livermore Lab., CA). May 1979.

In Special purpose materials. Annual progress report.

High energy neutron irradiations have been performed on Nb_3Sn superconductors to assess their behavior in a fusion reactor environment. Irradiations were performed at 4.2 K and property measurements were made without warming the samples. The critical current I/sub c/ increased with irradiation to a level about 50% above the unirradiated value at the highest fluences reached in our experiments. These results are compared with the results of other low temperature irradiations of Nb_3Sn.

43432 **Irradiation-enhanced coarsening in Ni—12.8 at. % Al.** Potter, D.I.; McCormick, A.W. (Argonne National Lab., IL). *Acta Metall.;* **27**: No. 6, 933-941(Jun 1979).

Precipitation of γ'-Ni_3Al in Ni—12.8 at. % Al was investigated during low-dose irradiation with 3.5 MeV $^{58}Ni^+$ ions at 450 to 700°C. Mean precipitate size, number density, and volume fraction were determined by transmission electron microscopy (TEM). At constant displacement rate, mean γ' size increased with the one-third power of irradiation dose at all temperatures investigated, consistent with a diffusion-controlled (Lifschitz-Slyozov-Wagner) model for precipitate coarsening during aging. The vol % of precipitate increased rapidly early in the irradiation, then reached and maintained a constant value consistent with coarsening during thermal aging. Log—log plots of precipitate number density vs dose are linear with slope ~ -1.0, as predicted by coarsening theory. The rate constants observed for irradiated samples were always greater than those observed at the same temperatures during thermal aging. The difference decreased at higher temperature (~ 700°C). The rate constants reached a plateau between 500 and 600°C with $k \simeq 10^6$ A³/h, close to the value observed during electron irradiation of this alloy. The significance of the similarity between the effects of heavy-ion and electron irradiation for cascade dissolution of precipitates is discussed. Agreement between observed and calculated rate constants is good, particularly in view of the changing sink structure with irradiation temperature.

43433 **Correlation of blister diameter and blister skin thickness in helium-ion-irradiated Nb.** Das, S.K.; Kaminsky, M.; Fenske, G. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Appl. Phys.;* **50**: No. 5, 3304-3311(May 1979).

A systematic study of the correlation between blister diameter and blister skin thickness has been performed for helium-ion irradiation of monocrystalline and polycrystalline Nb for ion energies ranging from 20 to 500 keV. The results indicate that a relationship D@sub mp@proportionalt@sup 1.50@ between the most probable blister diameter, D@sub mp@, and blister skin thickness, t, which has been suggested by other authors, does not exist for the various types of Nb targets studied. For example, for room-temperature irradiation of annealed polycrystalline Nb the experimentally determined relationship is D@sub mp@ < 10.3t@sup 1.22@. Furthermore, the D-t relationship was found to depend on the irradiation temperature in contrast to theoretical predictions by the lateral stress model of blister formation. These results do not appear to support the lateral stress model which predicts the relationship Dproportionalt@sup 1.5@. However, the experimentally determined relationships can be explained in part by the gas pressure model of blister formation.

43434 **Vacancy reactions in stage III recovery of molybdenum.** Kissinger, H.E.; Brimhall, J.L. (Pacific Northwest Lab., Richland, Washington). *Scr. Metall.;* **13**: No. 5, 327-328(May 1979).

Single-crystal rods of high-purity Mo were prepared by zone refining and irradiated at 40°C in the Hanford reactor. Post-irradiation study included isochronal annealing, lattice parameters and hardness. Resistance and hardness recovery proceed normally. Lattice parameter changes were not observed under 200°C. Resistance decrease indicates fewer scattering centers.

CERAMICS, CERMETS, AND REFRACTORIES

43435 **Electroreflectance spectroscopy of Ga-group V semiconductors using synchrotron radiation.** Lynch, D.W. (Ames Lab., IA). *Chin. J. Phys. (Taiwan);* **15**: No. 2, 132-140(Sum 1977).

Synchrotron radiation from the 240 MeV electron storage ring Tantalus I has been used as a light source for the electroreflection spectroscopy of GaP, GaAs, and GaSb in the 5 to 30 eV energy range. After a brief discussion of the characteristics of synchrotron radiation, we discuss the spectra in the 20 to 25 eV region arising from the excitation of Ga 3d electrons to various conduction band minima. These small field third derivative spectra exhibit little anisotropy, unlike those produced by valence band excitations. For GaP, the line shape of a single spin-orbit component has been fitted with Blossey's theory, obtaining an exciton rydberg of 160 MeV and an exciton broadening parameter of 160 MeV. A comparison of the electroreflectance spectra with those obtained by x-ray-induced photoemission gives a core exciton rydberg of 170 MeV for GaP, and 90 MeV for both GaAs and GaSb. These values are larger than the effective mass values, but not so much that effective mass model is invalid as a zero-order approximation. In GaAs, the transitions to the conduction band minima at Γ, X, and L have been identified and the L minimum is found to be lower than that at X, contrary to the conventional ordering. The temperature dependence of the transitions can be accounted for by the temperature dependence of only the conduction band final states.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 42377

43436 **Structure and thermal diffusivity of plasma-sprayed Al_2O_3.** Hurley, G.F.; Gac, F.D. (Los Alamos Scientific Lab., NM). *Am. Ceram. Soc. Bull.;* **58**: No. 5, 509-511(May 1979).

Thermal diffusivity changes in plasma-sprayed alumina were examined in concert with macro- and microstructural changes following annealing treatments. It is shown that both the metastable Al_2O_3 phases and the porous and cracked microstructure affect thermal diffusivity. Further, since heat treatment to produce reversion to high conductivity α-Al_2O_3 is accompanied by a high degree of internal cracking, with concomitant loss of the enhanced conductivity and since further annealing results in large volume shrinkage, plasma spraying Al_2O_3 onto a cold substrate, followed by heat treatment, does not appear to be a satisfactory method for producing high conductivity shapes.

43437 **Arc-plasma-sprayed rutile anodes for photoelectrolysis of water.** Wang, R.; Henager, C.H. Jr. (Battelle, Pac Northwest Lab, Richland, Wash). *J. Electrochem. Soc.;* **126**: No. 1, 83-85(Jan 1979).

Rutile (TiO_2) anodes prepared by arc-plasma spraying of raw rutile powder containing Si, Fe, Cr, Ni, and Mn impurities performed similarly in photoelectrolysis experiments to polycrystalline TiO_2 electrodes made by chemical vapor deposition and by oxidation of metal foils. The impure arc-plasma-sprayed anodes showed photoresponse characteristics and flatband potential comparable to that of single crystal TiO_2, but the breakdown voltage was lower. The low breakdown voltage was attributed to electron tunneling through the thin depletion region of the strongly reduced TiO_2 via grain boundaries containing impurity atoms and second phases.

43438 **Densification and grain growth in doped $LiFe_5O_8$ spinel.** Bandyopadhyay, G.; Lacy, A.M.; Fulrath, R.M. (Univ. of California, Berkeley). *J. Am. Ceram. Soc.;* **57**: No. 10, vp(Oct 1974).

In processing ceramic materials, it is very often desirable to add small amounts of selected impurities to control sintering rates, grain growth, and physical and chemical properties. In the case of $LiFe_5O_8$, additives are crucial in developing a useful magnetic square-loop material. The influence of the dopants on densification and microstructure, which may themselves significantly influence the electrical and magnetic properties of the ferrite, has not been studied. The effects of common dopants, e.g. NiO, MgO, and TiO_2, on densification and grain growth in $LiFe_5O_8$ are reported.

43439 **Processing parameters and properties of lithium ferrite spinel.** Bandyopadhyay, G.; Fulrath, R.M. (Univ. of California, Berkeley). *J. Am. Ceram. Soc.;* **57**: No. 4, 182-186(Apr 1974).

Polycrystalline compacts of lithium ferrite with varying stoichiometry were sintered using a packing-powder technique and high-O_2 atmosphere to control the material loss from the system. These specimens were used to study the influence of sintering time and temperature and stoichiometry on the densification, microstructural characteristics, dc resistivity, and hysteresis-loop parameters of lithium ferrite. The influence of the packing-powder composition was also investigated.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 43436, 43438, 43439

43440 (CONF-790341—5) **Proton density modulation of D atoms in PdD/sub 1-x/.** Mueller, M.H.; Brun, T.O.; Hitterman, R.L.; Knott, H.W.; Satterthwaite, C.B.; Ellis, T.E. (Argonne National

Lab., IL (USA); Illinois Univ., Urbana (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

Recent resistivity and neutron diffraction measurements have provided evidence for ordering of D(H) atoms on the octahedral interstitial sites of PdD/sub 1-x/. This order—disorder transition is responsible for the 50 K anomaly which has been reported in many of the physical properties. Neutron diffraction measurements on a $PdD_{0.78}$ single crystal revealed satellite reflection at (4/5,2/5,0) and equivalent positions. These satellites can be accounted for by a multi-domained tetragonal unit cell with a/sub t/ = a/sub c/ root 5/2 and c/sub t/ = c/sub a/. This ordered state can be described as a deuteron density wave along a < 420 > cubic direction. This density is modulated such that four fully occupied planes (Pd and D) are followed by a vacant plane (Pd only).

43441 Cation stacking faults in lithium ferrite spinel. Van Der Biest, O.; Thomas, G. (Univ. of California, Berkeley). *Phys. Status Solidi (a);* **24**: No. 1, 65-77(1974).

Extended stacking faults were found in flux grown $LiFe_5O_8$ single crystals, using high voltage electron microscopy. The faults lie on (110) planes and have a displacement vector of 1/4 [110] which is always perpendicular to the fault plane. The faults often form three-fold junctions but can also be terminated by a dislocation with Burgers vector b = 1/4 [110]. From geometric and energetic arguments, it has been shown that for a 1/4 [110] fault, the plane perpendicular to the displacement vector will have the lowest surface free energy in a stoichiometric spinel. The influence of non-stoichiometry is discussed.

43442 Subgrain boundaries in MgO. Narayan, J. (Univ. of California, Berkeley). *J. Am. Ceram. Soc.;* **56**: No. 12, 644-647(Dec 1973).

The structure of subgrain boundaries in as-grown MgO was characterized by transmission electron microscopy. The types of subboundaries which occur quite frequently are (1) a pure tilt boundary consisting only of 1/2 [101]-type dislocations (A set); (2) a tilt boundary consisting mainly of 1/2 [101] (A set) and 1/2 [011] (B set) dislocations; and (3) a mixed boundary with 1/2 [101] (A set), 1/2 [011] (B set), and 1/2 [101] (C set) dislocations. At the nodes the following dislocation reactions occur: 1/2 [011] + 1/2 [101] = 1/2 [110] and 1/2 [101] + 1/2 [101] = [100]. The precipitation of impurities at the subboundaries and their role in pinning the subboundaries are discussed.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 42901, 43437

43443 (DOE/ET—0095, pp 45-52) **Fracture toughness and hardness of neutron-irradiated ceramics.** Hurley, G.F.; Clinard, F.W. Jr. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

Three candidate ceramics ($MgAl_2O_4$, Al_2O_3, and $Y_3Al_5O_{12}$) in single crystal form were irradiated at elevated temperatures in ERB-II. Fracture toughness (resistance to crack propagation) and hardness (resistance to plastic flow) were then measured at room temperature by a microindentation technique. $MgAl_2O_4$ and $Y_3Al_5O_{12}$ irradiated to 0.3 x 10^{22} n/cm^2 (E/sub n/ > 0.1 MeV) at 1015 K showed essentially no change in these parameters, while Al_2O_3 exhibited an increase in both. The same three ceramics were irradiated to ~ 1 to 2 x 10^{22} n/cm^2 at 925 and 1100 K. Thus far Al_2O_3 has been evaluated, and fracture toughness and hardness were again found to be increased over that for unirradiated material. The increases for Al_2O_3 are attributable to the presence of voids and dislocation tangles induced by irradiation, while lack of significant change for $MgAl_2O_4$ and $Y_3Al_5O_{12}$ is consistent with the modest microstructural changes observed.

43444 (DOE/ET—0095, pp 57-58) **Technique for measuring swelling in small ceramic samples.** Hurley, G.F.; Clinard, F.W. Jr. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

A technique has been developed to measure swelling of small ceramic samples such as will be irradiated at RTNS II and FMIT. Samples are placed in a thallous formate—thallous malonate solution and suspended by adding a more-dense or less-dense solution as appropriate. A calculating digital density meter is used to measure the density of the suspending solution, which is also that of the sample. Accuracy is one part in 10^3 for routine analysis and can be as high as one part in 10^4 if required.

43445 (DOE/ET—0095, pp 73-75) **Evaluation of TFTR neutral beam injector insulator problems.** Clinard, F.W. Jr.; Hauth, W.E.; Hurley, G.F. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

LASL was asked by OFE/DOE to investigate cracking problems in MACOR insulators for the TFTR neutral beam injector ion source, and develop a plan for their solution. It was found that cracking occurred both during machining of this glass-ceramic (due to high residual stresses) and during brazing (as a result of marginal metallizing and brazing procedures). It was recommended that future work be expanded to include more active development of the backup material (ground alumina). Tasks to be pursued included characterization and optimization of MACOR, optimization of the existing braze, development of a new braze, and development of new materials and/or processes. The work described was designed to be completed within the nine-month time limit.

43446 Some geometrical aspects of breakdown of sodium beta alumina. De Jonghe, L.C.; Feldman, L.; Millett, P. (Cornell Univ., Ithaca, NY). *Mater. Res. Bull.;* **14**: No. 5, 589-595(May 1979).

The breakdown of single and pollycrystalline sodium beta alumina was studied at 300°C and at room temperture. The breakdown in polycrystals involves a propagation of a highly-branched sodium-filled crack network. In single crystals the fracture surface could be studied directly. It was found that the crack network is filled with sodium from the crack faces rather than the crack tip.

43447 High-temperature deformation of polycrystalline magnesium oxide. Snowden, W.E.; Pask, J.A. (Univ. of California, Berkeley). *Philos. Mag.;* **29**: No. 3, 441-455(Mar 1974).

The mechanical behaviour of two types of polycrystalline MgO was studied in compression over the temperature range 1200-1400°C. Differences in behaviour between hot-pressed specimens and specimens which were hot-pressed, then annealed, were attributed to differences in the structure of the grain boundary regions. Results indicate that creep in the hot-pressed specimens was controlled by a grain boundary sliding mechanism characterized by the movement of dislocations along grain boundaries, with a stress exponent n = 1.8 and an apparent activation energy for the process of ~ 70 kcal/mol. Creep in the specimens which were also annealed was found to be controlled by a dislocation climb mechanism within the grains, with a stress exponent n = 7 and an apparent activation energy of ~ 110 kcal/mol.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 43436, 43439, 44153

43448 (CONF-790301—11) **Electronic specific heats in metal—hydrogen systems.** Flotow, H.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 34p. Dep. NTIS, PC A03/MF A01.

From Hydrogen in metals international meeting; Munster, F.R. Germany (6 Mar 1979).

The electronic specific heats of metals and metal—hydrogen systems can in many cases be evaluated from the measured specific heats at constant pressure, C/sub p/, in the temperature range 1 to 10 K. For the simplest case, C/sub p/ = $\gamma T + \beta T^3$, where γT represents the specific heat contribution associated with the conduction electrons, and βT^3 represents lattice specific heat contribution. The electronic specific heat coefficient, γ, is important because it is proportional to electron density of states at the Fermi surface. A short description of a low temperature calorimetric cryostat employing a $^3He/^4He$ dilution refrigeration is given. Various considerations and complications encountered in the evaluation of γ from specific heat data are discussed. Finally, the experimental values of γ for the V—Cr—H system and for the Lu—H system are summarized and the variations of γ as function of alloy composition are discussed.

43449 (SAND—79-0541C) **Effect of additives and moisture on the ionic conductivity of Li_5MO_4 (M = Al, Ga, Fe).** Johnson, R.T. Jr.; Biefeld, R.M. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 11p. (CONF-790538—3). Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

When polycrystalline Li_5MO_4 (M = Al, Ga, Fe) is exposed to moisture, LiOH is formed within the material and produces a dramatic increase in the conductivity above ~ 400°C. The addition of Li_2SO_4 shifts this temperature to ~ 350°C due to a LiOH—Li_2SO_4 eutectic reaction. In the dry state, Li_2SO_4 additions increase the conductivity (10 to 100 times) to ~ 10^{-1} (ohm-cm)$^{-1}$ at 600°C. Annealing to 650°C in dry environments increases the conductivity activation energy from ~ 0.6 to ~ 1.0 eV, apparently due to the removal of LiOH from surface and grain boundary regions. Electron microprobe results support the suggestion that grain boundary effects significantly influence the conductivity characteristics of these materials.

43450 Study of surface stoichiometry and thermionic emission using LaB_6. Storms, E.K.; Mueller, B.A. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Appl. Phys.;* **50**: No. 5, 3691-3698(May 1979).

The variables which influence the surface composition of vaporizing compounds have been studied using the behavior of LaB_6 as an example. The thermionic work function of LaB_6 has been determined as a function of surface stoichiometry. A nearly constant value of 2.93 eV for the effective work function was observed from the $LaB_6 + LaB_4$ boundary up to approximately LaB@sub 6.06@. A further increase in boron content caused a steep increase reaching 3.40 eV at the $LaB_6 + LaB_9$ boundary at 1500 K. The interior composition which produces a surface composition having a high emission flux and the lowest attrition rate is in the high boron region near LaB@sub 6.5@, not at the stoichiometric composition.

43451 Positron lifetime study of $Fe_{40}Ni_{40}P_{14}B_6$ glass. Howell, R.H.; Hopper, R.W. (Univ. of California, Livermore). *Scr. Metall.;* **13**: No. 5, 367-370(May 1979).

Positron lifetimes were measured in the as-received alloy after treatment to embrittle, crystallize, or deform the alloy thus changing its internal structure.

43452 Spin wave excitation by carriers in the magnetic semiconductors EuO and $CdCr_2Se_4$. Samokhvalov, A.A.; Osipov, V.V.; Kalinnikov, V.T.; Aminov, T.G. (Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 382-385(20 Sep 1978).

The decrease of the magnetization and of the electric conductivity of the magnetic semiconductors EuO and $CdCr_2Se_4$ in a strong electric field, due to spin-wave excitation by the carriers, is investigated.

43453 Melting point of yttria. Skaggs, S.R. (Las Alamos Scientific Lab., NM). *High Temp. Sci.;* **9**: 197-207(1977).

Fourteen samples of 99.999% Y_2O_3 were melted near the focus of a 250-W CO_2 laser. The average value of the observed melting point along the solid—liquid interface was 2462 +- 19°C. Several of these same samples were then melted in ultrahigh-purity oxygen, nitrogen, helium, or argon, and in water vapor. No change in the observed temperature was detected, except for an approx. 20°C increase in temperature from air to helium gas. Post-test examination of the sample characteristics, clarity, sphericity, and density is presented, along with composition. It is suggested that yttria is superior to alumina as a secondary melting-point standard.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 42193

43454 (N—79-11179) **Thermal barrier coatings: Burner rig hot corrosion test results. Final report.** Hodge, P.E.; Stecura, S.; Gedwill, M.A.; Zaplatynsky, I.; Levine, S.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1978. Contract EF-77-A-01-2593. 35p. NTIS PC A03/MF A01.

A Mach 0.3 burner rig test program was conducted to examine the sensitivity of thermal barrier coatings to Na and V contaminated combustion gases simulating potential utility gas turbine environments. Coating life of the standard ZrO2-12Y2O3/Ni-16.2Cr-5.6Al-0.6Y NASA thermal barrier coating system which was developed for aircraft gas turbines was significantly reduced in such environments. Two thermal barrier coating systems, Ca2SiO4/Ni-16.2Cr-5.6Al-0.6Y and ZrO2-8Y2O3/Ni-16.4Cr-5.1Al-0.15Y and a less insulative cermet coating system, 50 volume percent MgO-50 volume percent Ni-19.6Cr-17.1Al-0.97Y/Ni-16.2Cr-5.6Al-0.6Y, were identified as having much improved corrosion resistance compared to the standard coating.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 44152, 44157, 44158

43455 (DOE/ET—0095, pp 53-56) **Strength degradation and internal strain in irradiated sialon and silicon oxynitride.** Hurley, G.F.; Clinard, F.W. Jr. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

Sialon ($Si_4Al_2O_2N_6$ + 5 wt % Y_2O_3) and silicon oxynitride (Si_2ON_2) were irradiated to 2.8 x 10^{21} n/cm^2 (E/sub n/ > 0.1 MeV) at 1015 K in EBR-II. Subsequent diametral compression tests showed that tensile strengths of these ceramics had decreased by 17% and 18% respectively. X-ray line broadening studies are being carried out to determine the magnitude of internal strain induced by irradiation. Results to date show an increase in internal strain for the predominant silicon oxynitride phase but a strain increase only in a minor phase in sialon. These findings suggest that the former ceramic may be intrinsically sensitive to radiation damage, but that changes in composition or processing for sialon might imorove its radiation resistance by altering the nature of the affected phase.

43456 (DOE/ET—0095, pp 59-64) **Thermal diffusivity of neutron-irradiated ceramics.** Hurley, G.F.; Clinard, F.W. Jr. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

Fourteen candidate ceramics (eleven oxides and three nitrides) were irradiated in EBR-II to dose between 0.3 and 2.3 x 10^{22} n/cm^2 (E/sub n/ > 0.1 MeV) at 925, 1015, and 1100 K. Thermal diffusivity (which is approximately proportional to thermal conductivity) was subsequently measured at room temperature by a xenon flash technique. Diffusivity usually decreased sharply as a function of fluence at low doses, but tended toward saturation at higher doses. In most cases lower irradiation temperatures resulted in greater degradations in thermal diffusivity. The magnitude of reduction varied greatly with the ceramic tested, ranging from single-crystal $MgAl_2O_4$ (~ 3%) to polycrystalline silicon oxynitride (93%). In most materials tested the reductions were great enough to raise thermal stresses significantly in low temperature, high thermal flux applications.

43457 (DOE/ET—0095, pp 65-67) **Plan to simulate transmutation gas effects in a neutron-irradiated ceramic.** Clinard, F.W. Jr.; Hurley, G.F. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

A plan has been developed to simulate He and H gas production expected in fusion neutron-irradiated ceramics. A sialon ceramic ($Si_3Al_3O_3N_5$) was chosen as the model material, with controlled amounts of ^{17}O and ^{14}N used to generate He and H by transmutation reactions. The ORR mixed spectrum fission reactor is specified as the irradiation source, with thermal neutrons generating the gases and fast neutrons inducing the desired displacement damage. By adjusting the isotopic content, four different damage states can be attained: displacement damage only, displacement plus He production, displacement plus H production, and displacement with both He and H generated as in a fusion reactor.

43458 (DOE/ET—0095, pp 69-72) **Fission reactor irradiation of candidate ceramics.** Clinard, F.W. Jr.; Hurley, G.F. (Los Alamos Scientific Lab., NM). May 1979.

In Special purpose materials. Annual progress report.

Samples of eleven candidate ceramics (MgO. xAl_2O_3 in five forms, and Al_2O_3, Si_3N_4 and SiC in two forms each) have been sent to the EBR-II fission reactor for neutron irradiation testing. EBR-II is being used because of its high neutron flux and the absence of thermal neutrons which cause undesirable nuclear reactions with ^{14}N. The four families of ceramics selected for inclusion have all shown acceptable performance in irradiation tests carried out by the LASL Ceramics Program or by others. The present study will in some cases yield results at temperatures not yet investigated, and in others will allow the evaluation of forms of these ceramics never before irradiated. Samples will be irradiated at 675 and 825 K to ~ 2.4 x 10^{22} n/cm^2 (E/sub n/ > 0.1 MeV), after which changes in electrical, mechanical, and thermal properties will be determined.

43459 (DOE/ET—0095, pp 77-84) **Defect microstructures in Al_2O_3 and Y_2O_3 subjected to ion irradiation.** Rechtin, M. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

Transmission electron microscopy was used to monitor the changes in the microstructures of Y_2O_3 and Al_2O_3 induced by light ion irradiations conducted at temperatures between 500 and 1250 K. Results on Y_2O_3 were highlighted by the relatively low defect density, the isotropic nature of the damage, and the precipitation of a metastable phase during irradiation. In alumina, pore arrays are formed in much the same manner as has been observed after neutron bombardment. These arrays were found to be aligned along the c axis of the material. Strong synergistic effects between helium and point defects were observed.

43460 (DOE/ET—0095, pp 91-99) **Description of the EBR-II irradiation of insulator materials.** Porter, D. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

An EBR-II irradiation of insulator and coating materials has been planned and approved. Irradiation is scheduled to begin in early March at ~ 400 and 500°C.

43461 (DOE/ET—0095, pp 113-114) **Cryogenic radiation effects on organic insulators.** Long, C.J.; Kernohan, R.H.; Coltman, R.R. Jr. (Oak Ridge National Lab., TN). May 1979.

In Special purpose materials. Annual progress report.

After 20 MGy (2 x 10^9 rd) at 5 K, electrical properties in most systems tested are degraded but not below usable levels. Mechanical property changes, by contrast, are likely to require derating. Two wire varnishes tested are damaged but still usable. Aluminized Mylar superinsulation is at or beyond the end of its useful life.

COMPOSITE MATERIALS

PHYSICAL PROPERTIES

43462 (CONF-790341—7) **Modulated structures in inorganic one-dimensional metals.** Williams, J.M.; Schultz, A.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From International conference on modulated structures; Kailua-Kona, HI, USA (22 Mar 1979).

The formation and nature of modulated structures in one-dimensional inorganic metals are discussed. Partially oxidized tetracyanoplatinate and bisoxalatoplatinate complexes comprise a class of inorganic materials known for their highly one-dimensional (1-D) electrical conductivity. Their crystal structures derive basically from linear, or nearly linear, stacks of square planar [Pt(CN)$_4$]/sup -x/ or [Pt(C$_2$O$_4$)]/sup -y/ groups (x = 1.6 to 1.75, y = 1.60 to 1.65) in which overlapping Pt d/sub z/2 orbitals form a 1-D metallic band. In all cases a characteristic feature of these 1-D metals is the existence of a modulated structure. This structural feature derives from a modulation of the average atomic positions which arises from electron—phonon coupling, and the study of this phenomena provides important insight into the underlying conduction band properties of the material.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 42193

POLYMERS AND PLASTICS

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 42258

43463 (SAND—79-0894C) **Accelerated aging of parachute materials.** Wagner, J.A.; Mead, K.E.; Auerbach, I.; Ericksen, R.H. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76-DP00789. 6p. (CONF-790632—3). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

Sandia Laboratories has design responsibility for weapons system parachutes with intended lifetimes of twenty to twenty-five years. These parachutes are fabricated from narrow woven fabric of nylon and Kevlar. In a review of known data from past investigations of nylon and Kevlar, I. Auerbach concluded that previous real time storage and laboratory tests have been generally inconclusive and do not relate well to our requirements for long stockpile lifetimes. A serious deficiency in most studies was the lack of initial material strength data making it impossible to establish the extent of degradation. This study will establish accelerated aging data which will be extrapolated to real time conditions.

43464 (SAND—79-0924C) **Study of strong synergism in polymer degradation.** Clough, R.L.; Gillen, K.T.; Salazar, E.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76-DP00789. 9p. (CONF-790632—4). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

Anomalous strong interactions of radiation and thermal effects in the degradation of polyethylene and polyvinyl chloride are discussed. The interactions are found to occur in both simultaneous and sequential radiation-elevated temperature experiments, and are totally blocked in the absence of oxygen. A mechanism is proposed by which the effects can be understood in terms of a time-dependent thermal amplification of initial radiation damage; the phenomena results from thermal breakdown of peroxides as a rate limiting step in the radiation-induced degradation.

43465 (SAND—79-0925C) **Implications of sorption effects on accelerated aging studies.** Gillen, K.T. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76-DP00789. 13p. (CONF-790632—5). Dep. NTIS, PC A02/MF A01.

From JOWOG-28; Albuquerque, NM, USA (11 Jun 1979).

Whenever a material degrades due to reactions with a surrounding gaseous medium, the sorption characteristics of the material can have a profound and largely unrecognized influence on any attempts at quantitatively accelerating the degradation. For oxidative degradation, the analysis presented indicates that the activation energy obtained from an Arrhenius treatment is a linear combination of the true activation energy and the heat of sorption of oxygen. If material degradation is due to a reaction with a condensable such as water vapor, then a non-Arrhenius temperature dependence is expected for experiments run at constant gaseous concentration. If, however, the experiments are run and analyzed at constant relative pressure (relative humidity for water vapor) then Arrhenius behavior is often recovered.

43466 **Analysis of slow crack propagation data in PMMA and brittle materials.** Pollet, J.C.; Burns, S.J. (Univ. of Rochester, NY). Contract E(11-1)-2422. *Int. J. Fract.;* **13**: No. 6, 775-786(Dec 1977).

Slow crack propagation data in PMMA previously published by Atkins et al. are reanalyzed in terms of a thermodynamic model in which the activation area is inversely proportional to the crack extension force. Important thermodynamic activation parameters are derived from the data. A correlation between the activation area and the crack extension force is observed in many brittle materials; it is compared to Li's general correlation for activation areas in creep.

43467 **Thermally activated crack propagation-theory.** Pollet, J.C.; Burns, S.J. (Univ. of Rochester, NY). *Int. J. Fract.;* **13**: No. 5, 667-679(Oct 1977).

Steady state crack propagation in solids is analyzed as a thermally activated process. The fracture mechanics concept of a crack driving force is formally introduced to molecular rate theory. This representation of crack propagation appears to be, in many aspects, similar to that of the motion of a dislocation under a shear stress across thermal obstacles. The basic thermodynamic relations are derived for steady state crack propagation using assumptions similar to those well accepted in theories of deformation based on thermally activated dislocation motion.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 42949

43468 **Fluorescent and Raman scattering by molecules embedded in small particles: Magnetic dipole transitions.** Chew, H. (Department of Physics, Clarkson College, Potsdam, New York 13676). *Phys. Rev., A;* **19**: No. 5, 2137-2138(May 1979).

A classical model for fluorescent and Raman scattering by molecules embedded in small spherical particles has been formulated recently by Chew, McNulty, and Kerker, on the assumption that the dominant transitions are electric dipole transitions. In this Addendum results are given for those cases where the dominant transitions are magnetic dipole.

OTHER MATERIALS

REFER ALSO TO CITATION(S) 42160, 42161

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 42565, 42567, 42568, 42569, 42580, 42582, 42593, 42600, 42601, 42602, 42603, 42604, 42606, 42609, 42610, 42612

43469 (BNL-NUREG—25735) **Removal of iron from impure graphites.** Growcock, F.B.; Heiser, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790625—5). Dep. NTIS, PC A02/MF A01.

From 14. carbon conference; University Park, PA, USA (25 Jun 1979).

Iron-impregnated and ash-rich graphites have been purified by leaching with gaseous I_2 at 900°C. With addition of H_2, the rate of removal of impurity iron can be markedly increased and becomes comparable to that obtained with Cl_2. I_2 has an advantage in that it can also volatilize Ca and perhaps Ba and Sr.

43470 (UCID—18201) **Preliminary machining study on fluoroberyllate laser glass. Final report.** Baker, P.C.; Maney, R.T.; Sanger, G.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jun 1979. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

A series of scribe tests of fluoroberyllate glass using a radiused diamond tool indicated the possibility of this glass being a candidate for diamond machining. Based on the scribe tests, an effort was undertaken using existing conventional equipment to explore the machinability of fluoroberyllate (836 Corning glass) with a machine parameter study. A series of cuts of varying depths was completed using Heptyl Alcohol as a coolant. Nomarski microphotographs and Celvite profilometer scans were made of the surface after each run. Microphotographs of the tool were made to document tool wear. The results of this study indicated that substantial amounts of the fluoroberyllate glass could be removed without any visible damage to the diamond tool.

43471 **Growth of tin oxide films at room temperature.** Ghandhi, S.K.; Siviy, R.; Borrego, J.M. (Electrical and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, New York 12181). *Appl. Phys. Lett.;* **34**: No. 12, 833-835(15 Jun 1979).

This report outlines the growth of highly transparent films of undoped tin oxide at near ambient temperatures (~30°C). Films

were deposited by a technique based on the reaction of rf plasma-activated oxygen with tetramethyltin. Growth rates as high as 160 A/min have been achieved with a 100-μm partial pressure of tetramethyltin and an overall system pressure of 500 μm. The growth kinetics have been explained by a model in which the tetramethyltin is the rate limiter, and the concentration of active oxygen is independent of the flow rate of molecular oxygen.

43472 Crystal nucleation and growth in liquid rubidium. Hsu, C.S.; Rahman, A. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **70**: No. 11, 5234-5240(1 Jun 1979).

Molecular dynamics technique is used to study the homogeneous nucleation of an ordered stable phase from a liquidlike state of aggregation. The rubidium potential is used for a 500 particles system with reduced density 0.95. At the start of the calculation the system is quenched rapidly from a reduced temperature of 0.8 to 0.1. The moment of nucleation and the explosive growth of the nucleus to engulf the whole system have been monitored by studying the characteristics of Voronoi polyhedra in addition to quantities such as temperature, pressure, pair correlation functions, etc. After nucleation, the surface of the nucleus is found to advance at a rate of about 130 m/sec; the size of the critical nucleus is estimated to contain 40 to 70 particles. The ordered stable phase is found to have a bcc structure. In spite of the very rapid rate of cooling which was used to start the calculation, a metastable disordered structure was not obtained.

43473 Formation of superconducting Nb_3Si by explosive compression. Dew-Hughes, D.; Linse, V.D. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.;* **50**: No. 5, 3500-3504(May 1979).

The claim that the high-temperature equilibium tetragonal Nb_3Si phase can be transformed, by explosive compression, into a superconducting phase has been confirmed. After being subjected to shock compression with peak pressure close to 1 Mbar, the resulting material is superconducting, with an onset T/sub c/ of 18 K. The structure of this superconducting phase is ambiguous, but it could have the A15 structure with a lattice parameter of 5.12 A.

43474 a-Si : H produced by high-temperature thermal decomposition of silane. Wiesmann, H.; Ghosh, A.K.; McMahon, T.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.;* **50**: No. 5, 3752-3754(May 1979).

Hydrogenated amorphous silicon has been deposited by a new technique of thermal decomposition of silane from a hot tungsten or carbon foil heated to about 1600 °C. Initial measurements indicate that the resulting films have a fairly high photoresponse. Introduction of ammonia along with silane is seen to enhance the photoconductivity quite significantly.

43475 (UCRL-Trans—1554) **Study of conditions of crystallization of zinc diphosphides.** Sysoev, B.I.; Aleinikova, K.B.; Bityutskaya, L.A.; Synorov, V.F.; Ugai, Ya.A. (AN SSSR, Novosibirsk. Inst. Neorganicheskoj Khimii; AN SSSR, Novosibirsk. Inst. Fiziki Poluprovodnikov). Aug 1978. Translated from All-Union symposium on processes of growth and synthesis of semiconducting crystals and films, 3d, Volume 2, 252-255, Novosibirsk, 1975. 9p. Dep. NTIS, MF A01.

Portions of document are illegible.

The conditions of the crystallization of zinc diphosphide are examined both from fusion and from the gaseous phase in the wide interval of temperatures (640 to 1050°C) and pressures of phosphorus of 0.1-52 atmospheres.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 42570, 43475

43476 (BNL—26099) **Single particle excitations in $RbAg_4I_5$.** Shapiro, S.M.; Salamon, M.B. (Brookhaven National Lab., Upton, NY (USA); Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790538—4). Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

In an inelastic neutron experiment on $RbAg_4I_5$ a broad quasielastic peak was observed throughout Q-space. As the temperature was lowered, the quasielastic peak became a broad propagating excitation with dirac constant $\omega \sim 2.2$ meV. This excitation was measured along several symmetry directions and it exhibited little dispersion. This confirms that the original idea of a single particle excitation corresponding to the Ag^+ ions moving within a potential well created by the rest of the lattice. The temperature dependence of this excitation is consistent with recent calculations of neutron scattering in superionic conductors.

43477 Characteristics of trapped electrons and electron traps in single crystals. Budzinski, E.E.; Potter, W.R.; Potienko, G.; Box, H.C. (Biophysics Department, Roswell Park Memorial Institute, Buffalo, New York 14263). *J. Chem. Phys.;* **70**: No. 11, 5040-5044(1 Jun 1979).

Two additional carbohydrates are reported whose crystal structures trap electrons intermolecularly in single crystals x irradiated at low temperature, namely sucrose and rhamnose. Five carbohydrate and polyhydroxy compounds are now known which exhibit this phenomenon. The following characteristics of the phenomenon were investigated: (1) the hyperfine couplings of the electron with protons of the polarized hydroxy groups forming the trap; (2) the distances between these protons and the trapped electron; (3) the spin density of the electron at the protons and (4) the relative stabilities of the electron trapped in various crystal structures.

43478 Cold-stage microscopy system for fast-frozen liquids. Talmon, Y.; Davis, H.T.; Scriven, L.E.; Thomas, E.L. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Rev. Sci. Instrum.;* **50**: No. 6, 698-704(Jun 1979).

The least artifact-laden fixation technique for examining colloidal suspensions, microemulsions, and other microstructured liquids in the electron microscope appears to be thermal fixation, i.e., ultrafast freezing of the liquid specimen. For rapid-enough cooling and for observation in TEM/STEM a thin sample is needed. The need is met by trapping a thin layer (~100 nm) of liquid between two polyimide films (~40 nm thickness) mounted on copper grids and immersing the resulting sandwich in liquid nitrogen at its melting point. For liquids containing water, polyimides films are used since this polymer is far less susceptible to the electron beam damage observed for the commonly used polymer films such as Formvar and collodion in contact with ice. Transfer of the frozen sample into the microscope column without deleterious frost deposition and warming is accomplished with a new transfer module for the cooling stage of the JEOL JEM-100CX microscope, which makes a true cold stage out of a device originally intended for cooling specimens inside the column. Sample results obtained with the new fast-freeze, cold-stage microscopy system are given.

PROPERTIES

REFER ALSO TO CITATION(S) 42570, 42579, 42580, 42589, 42590, 42591, 42605, 42607, 42626, 43476, 43866, 44059

43479 (ANL—79-3) **Thermal conductivity of the helium-argon system.** Purohit, A.; Moszynaki, J.R. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

A semiempirical relation for the thermal conductivity of helium—argon gas mixtures is suggested. The analyses used in support of the proposed conductivity relations are based on low-temperature ($T < 800$°C) thermal conductivity data for helium, argon and helium—argon mixtures. The report is a compilation of available data and theories, and does not contain any new experimental results. With the approach presented here, one should be able to predict thermal conductivities of helium—argon mixtures to within 5% of their true values for temperatures up to 1200 K. The recommended equations are best estimates and should be treated as such. A definite need exists for experimental data to verify or modify the recommendation.

43480 (BNL—25396) **Improvement of wear-resistance properties of natural aggregates by materials impregnation.** Webster, R.P.; Fontana, J.J. (Brookhaven National Lab., Upton, NY (USA)). Sep 1978. Contract EY-76-C-02-0016. 36p. (CONF-7810178—1). Dep. NTIS, PC A03/MF A01.

From FCP research review conference; College Park, MD, USA (3 Oct 1978).

The highway construction industry uses several billion tons of aggregate annually in the construction of highway pavement and bridge decks. In the interest of highway safety and maintenance, it is important that the aggregates used for pavement surfacing systems possess a high resistance to polishing as well as a high resistance to wear and weathering. Unfortunately, the supply of natural aggregates satisfying these criteria is being rapidly depleted in many areas of the United States, necessitating the shipment of large quantities of high quality aggregate to these regions. The preliminary phase of a research program being conducted to investigate impregnation materials and techniques to improve the wear resistance properties of natural aggregates, thereby making them acceptable for use in pavement surfacing systems. Test results obtained during this phase of the research program are discussed.

43481 (COO—1198-1258) **Low-energy excitation spectra of Li, Na, K and Ag β-alumina.** Anderson, A.C. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 14p. (CONF-790538—2). Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

Low-temperature measurements have disclosed that M-β alumina contains a broad spectrum of localized excitations ranging in energy from at least 0.03 cm^{-1} to 30 cm^{-1} and having a density of, roughly, 0.1/unit cell. It has been determined that the M ions are involved, and hence the excitations are constrained to the conducting planes. Atomic motion associated with an excitation occurs only in a direction perpendicular to the crystalline c-axis with the exception of Li β-alumina, in which motion also occurs parallel to the c-axis. The excitations appear to be similar to those found in amorphous materials, and thus may originate in the disorder characteristic of the conducting planes in β-alumina. The excitations probably arise from configurational changes accommodated by quantum-mechanical tunneling of M ions. 28 references.

43482 Valence compensation of thermally-generated [Li]^0 defects in MgO. Boldu, J.L.; Abraham, M.M.; Chen, Y. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **19**: No. 9, 4421-4426(1 May 1979).

The creation of thermally generated [Li]^0 defects (configuration: O^{2-}-Li^+-O^-) and other lithium-associated centers in MgO is attended by valence changes of transition-metal impurities, such as Fe and Cr. The electron-paramagnetic-resonance (EPR) technique was used to monitor the concentrations of these impurities and the [Li]^0 defects as a function of the incubating temperature in static air. Although near the threshold temperature for [Li]^0 production the impurities may contribute a significant portion of the holes needed for the valence compensation of stable [Li]^0 defects, at higher temperatures ($\sim$ 1600 K) they can supply only a small percentage of the holes required. Since oxygen was found to be necessary for the formation of [Li]^0 defects, the primary source of holes at these high temperatures is attributed to the surface reaction: $O_2 \rightarrow 2\ O^{2-} + 4$ holes. The effects of optical bleaching and ionizing radiation at 77 K on the concentrations were studied as a function of incubating temperatures. Electron-nuclear double resonance (ENDOR) was used to probe the local environments of the [Li]^0 defects and other lithium-associated centers.

43483 Neutron scattering study of the incommensurate and commensurate phases of Rb_2ZnBr_4. de Pater, C.J.; Axe, J.D.; Currat, R. (Laboratorium voor Technische Natuurkunde, Werkgroep Fysische Kristallografie, Lorentzweg 1, Delft, Netherlands). *Phys. Rev., B: Condens. Matter;* **19**: No. 9, 4684-4690(1 May 1979).

Measurements are presented of the diffuse scattering corresponding to order-parameter fluctuations in the incommensurate phase ($200 < \text{or} \approx T < 355$ K), and the commensurate phase ($T <$ or $\approx$ 200 K) of Rb_2ZnBr_4. The diffuse-scattering distribution is ellipsoidal in shape with the principal axis along the modulation wave vector. The order-parameter fluctuations are quasielastic in both the incommensurate and the commensurate phase. Below the lock-in transition the diffuse-scattering distribution narrows in the b direction, which is the direction of spontaneous polarization in the commensurate phase. In addition to this quasielastic diffuse scattering, normal acoustic phonon branches are observed originating from the satellites. A Landau free-energy model is presented which is in nearly quantitative agreement with the measured temperature dependence of the modulation wave vector. The Landau free energy predicts the existence of a dielectric polarization wave in the incommensurate phase which has the periodicity of the third harmonic of the primary modulation wave. We have calculated the effect of an applied electric field on the diffraction pattern in the presence of the polarization wave. Measurements of the field dependence of the intensity of first- and higher-order satellites agree with the calculations; i.e., the intensity of the first- and third-order satellites is virtually independent of the field whereas the intensity of the second-order satellite is enhanced by the field.

43484 Optical and electrical properties of evaporated amorphous silicon with hydrogen. Ghosh, A.K.; McMahon, T.; Rock, E.; Wiesmann, H. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.;* **50**: No. 5, 3407-3413(May 1979).

The optical and electrical properties of evaporated amorphous silicon with hydrogen have been studied under various deposition conditions. Infrared measurements indicate that the hydrogen content of the films are comparable to a-Si : H films produced by other techniques. The optical-absorption coefficient below the band gap of $\sim$1.55 eV was measured to be $\sim$100 cm^{-1} for samples made at deposition temperatures of $\sim$275—325 °C. For these samples the photoresponse at room temperature and the temperature dependence of the conductivities were studied. Dark conductivities were found to be thermally activated for $T > 300$ K with activation energies of $\sim$0.75 eV. We found type-1 photoconductivity and investigated its dependence on the light intensity. When samples were heated to $\sim$175 °C in a vacuum and then exposed to air, they exhibited time-dependent increases in the dark conductivity and photoconductivity. This effect was reversible by a reanneal in a vacuum. High-temperature anneals to $\sim$450 °C increased the optical absorption below 1.4 eV and decreased the photoresponse significantly.

43485 Luminescence studies of the 1.36-eV band and the edge emission in melt-grown GaAs : Cu. Norris, C.B. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **50**: No. 5, 3658-3665(May 1979).

Using cathodoluminescence at 80—300 K, we have measured the injection-level dependence, frequency response, and temperature dependence of the 1.36-eV band and the 1.50-eV edge emission in melt-grown GaAs : Cu. The overall luminescence is relatively weak and the 1.36-eV band is accompanied by a broad emission in the range 1—1.4 eV. We find no inherent injection-level shift in the shape or peak energy of the 1.36-eV band. With increasing temperature, the 1.36-eV band quenches out with an activation energy of 0.1 eV or greater. The frequency response of the 1.36-eV band is remarkably flat for deep-center luminescence. However, the frequency response of the edge emission is unusually slow in GaAs : Cu, particularly in samples with higher Cu concentration. Variation in injection level causes a strong variation in branching between the 1.36-eV band and the edge emission which is not explicable in terms of occupancy effects related to the relative kinetics of the two bands. It is suggested that the 1.36-eV band results from a conduction-band-to-acceptor transition whose kinetics are dominated by another process such as equilibration of a carrier trapping level in resonance with the conduction-band continuum. The same process also controls the kinetics of the edge emission transition in GaAs : Cu with high Cu concentration.

43486 Mechanisms for hydrogen diffusion in TiO_2. Bates, J.B.; Wang, J.C.; Perkins, R.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 4130-4139(15 Apr 1979).

The predominant hydrogen-containing species in TiO_2 (rutile) are OH^- (hydroxyl) ions, in which the oxygen occupies a regular oxygen ion site, and the O-H bond is perpendicular to the c axis. It is proposed that diffusion of hydrogen parallel to the c axis proceeds by a proton jump from one O^{2-} ion to another along the channel as represented by $OH^-\ xxxO^{2-} \rightarrow O^{2-}\ xxxH^+\ xxxO^{2-} \rightarrow O^{2-}\ xxxHO^-$. It is also proposed that diffusion perpendicular to the c axis proceeds by a rotation of the OH^- bond to move the proton from one channel to an adjacent channel, followed by a proton jump to another O^{2-} ion in the same channel. From a potential-energy model, which includes a Morse function to represent the OH^- bond, as well as electrostatic and repulsive terms, the activation energies for hydrogen and tritium diffusion parallel to the c axis were calculated to be (including a zero-point energy correction) 0.60 and 0.69 eV, respectively, in good agreement with the respective experimental values of 0.59 and 0.75 eV. The calculated activation energy for diffusion perpendicular to the c axis was 1.23 eV (no zero-point energy correction), as compared to the experimental values of 1.28 and 1.11 eV, respectively, for hydrogen and tritium. The calculated equilibrium orientation of the OH^- ion in TiO_2 and the calculated stretching frequency of this species were also in good agreement with the respective experimental results.

43487 Superconductivity of sulfur at high pressures. Yakovlev, E.N.; Stepanov, G.N.; Timofeev, Y.A.; Vinogradov, B.V. (Institute of High Pressure Physics). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 340-342(20 Sep 1978).

A superconducting transition of a metallic sulfur modification that exists at high pressure has been observed. The superconducting transition temperature is 9.7 K.

43488 Superconductivity of sulfur at high pressure. Evdokimova, V.V.; Kuzemskaya, I.G. (Institute of High Pressure Physics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 360-362(20 Sep 1978).

At a pressure 200 kbar sulfur becomes superconducting at a temperature 5.7 +- 0.1 K.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 42902

43489 (PB—286936) **Investigation of advanced thermal-chemical concepts for obtaining improved MSW-derived products. Final report.** Hecht, N.L.; Duvall, D.S.; Fox, B.L. (Dayton Univ., OH (USA). Research Inst.). Aug 1978. 119p. NTIS PC A06/MF A01.

Although a number of resource recovery from refuse programs have been effective, the quality of the products recovered could be enhanced to improve their marketability. The purpose of this study was to investigate the potential of known processes that could improve the quality of the fuels or other products derived from the organic fraction in refuse. Possible processes for improving the quality of products from the organic fraction derived from municipal solid waste (MSW) were determined, and descriptions were developed for each process. An analytical framework for technical and economic assessment was developed to serve as a guide for analysis. Major thermal and chemical processes used in the

pulp and paper, wood, textile, and resource recovery industries were identified. This study concentrated on those processes designed to produce a carbon char, a powdered fuel, and liquid and gaseous fuels from the municipal solid waste. The chemical and thermal treatments of most interest were the Worcester Polytechnic's hydrogenation-liquefaction process, Wright-Malta's steam injection pyrolysis process, and cellulose embrittlement. Basic requirements were defined for producing a fine powdered fuel from the organic faction of MSW. More quantitative measurements of the embrittlement process parameters are recomended.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 43476, 43679

43490 Effects of pulsed ruby-laser annealing on As and Sb implanted silicon. White, C.W.; Pronko, P.P.; Wilson, S.R.; Appleton, B.R.; Narayan, J.; Young, R.T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Appl. Phys.;* **50**: No. 5, 3261-3273(May 1979).

The effects of pulsed (Q-switched) ruby-laser annealing of arsenic- and antimony-implanted silicon (1×10^{15} to $\sim 2 \times 10^{16}$ cm^{-2}) has been studied by Rutherford ion backscattering, TEM, and ion channeling. The laser pulses were of ~50-nsec time width and of 1.5—1.7 J/cm^2 energy density. Analysis of the dopant profiles before and after annealing leads to the conclusion that the dopants diffuse under normal kinetics in a melted silicon layer over an average time interval of about 0.27-μsec after the laser power has been absorbed. Recrystallization of the melt layer is by liquid-phase epitaxial regrowth from the substrate. The recrystallized zone is found to be free of significant structural defects for all specimens except the very highest antimony doses, in which case some near-surface (~400 Å) precipitation at dislocations is observed. Atom-location measurements reveal that 98—99% of the retained dopant is in substitutional lattice sites even when the dopant concentration greatly exceeds the limit of solid solubility. Only in the high-dose ($>10^{16}$ cm^{-2}) antimony case was significant loss of dopant (20—35%) observed as a consequence of laser processing. The high-dose antimony also had a lower substitutional fraction (~87%) compared to the other specimens.

43491 Radiation effects in hydrogen-impregnated vitreous silica. Shelby, J.E. (Sandia Laboratories, Livermore, California 94550). *J. Appl. Phys.;* **50**: No. 5, 3702-3706(May 1979).

γ irradiation of vitreous silica normally leads to the formation of a large number of optical defects and to an increase in density. Irradiation of hydrogen-impregnated vitreous silica suppresses the formation of these optical defects, but does result in the formation of large quantities of bound hydroxyl and hydride. This process is accompanied by the expansion (density decrease) of the glass. The rates of hydroxyl and hydride formation and the density decrease all are proportional to the square root of the applied dose. The mechanism responsible for these results is not clear at this time.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 42208, 43580

43492 (AGNS—1040-65) **Computer controlled quality of analytical measurements.** Clark, J.P.; Huff, G.A. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jan 1979. Contract ET-78-C-09-1040. 9p. (CONF-790542—1). Dep. NTIS, PC A02/MF A01.

From 33. annual technical conference of the American Society of Quality Control; Houston, TX, USA (14 May 1979).

A PDP 11/35 computer system is used in evaluating analytical chemistry measurements quality control data at the Barnwell Nuclear Fuel Plant. This computerized measurement quality control system has several features which are not available in manual systems, such as real-time measurement control, computer calculated bias corrections and standard deviation estimates, surveillance applications, evaluaton of measurement system variables, records storage, immediate analyst recertificaton, and the elimination of routine analysis of known bench standards. The effectiveness of the Barnwell computer system has been demonstrated in gathering and assimilating the measurements of over 1100 quality control samples obtained during a recent plant demonstration run. These data were used to determine equaitons for predicting measurement reliability estimates (bias and precision); to evaluate the measurement system; and to provide direction for modification of chemistry methods. The analytical chemistry measurement quality control activities represented 10% of the total analytical chemistry effort.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 42318, 43733, 43736

43493 (BM-IC—8793) **Gas analysis procedures applicable to flue gas desulfurization by the citrate process.** Beard, H.R.; Farley, K.R.; Crane, S.R.; Marchant, W.N. (Bureau of Mines, Washington, DC (USA)). 1979. 18p. Bureau of Mines, Washington, DC.

The citrate process for sulfur dioxide emission control was developed in pursuit of the Bureau of Mines goal of minimizing the adverse environmental impact of mineral-processing operations. This publication describes the gas analysis procedures used during development of the process. The research required the capability to analyze SO_2, H_2S, CO, CO_2, COS, volatile hydrocarbons, NO, NO_2, O_2, N_2, and H_2. The methods described include gas chromatography, electrochemical detection, infrared spectroscopy, and the use of a computer program to predict the product composition in complex reactions. Laboratory and pilot plant applications are discussed.

43494 (EPRI-EA—929) **Survey of chlorine analytical methods suitable for the power industry. Interim report.** Sengupta, C.; Heiz, G.R.; Gretz, J.W.; Higgins, P.; Peterson, J.C.; Sigleo, A.C.; Sugam, R. (Public Service Electric and Gas Co., Newark, NJ (USA); Maryland Univ., College Park (USA). Dept. of Chemistry). Oct 1978. 100p. Dep. NTIS, PC A05/MF A01.

This report contains the results of a study of four instrumental electrochemical and two colorimetric methods for chlorine analysis to determine which ones would be most suitable for power plant applications. The methods were: an automated amperometric titration, amperometry (using the NBS chlorine flux monitor), membrane probe amperometry (using the Delta Scientific Multi-Range Analyzer for Chlorine), potentiometry (using the Orion chlorine electrode), as well as methods based on the use of DPD and syringaldazine colorimetric reagents. At this time, we recommend the automated amperometric titration when concentrations below 0.1 mg/L Cl must be determined. A precision of +- 0.0015 mg/L has been obtained with standard solutions using this method for total halogen residual. However, in the future if an improved version of the NBS flux monitor becomes available, it will be an attractive alternative. For situations in which quantification below the 0.1 mg/L level is not needed, the Orion electrode is a comparatively inexpensive alternative, although it should be field tested before being adopted by a power company. The colorimetric methods appear to have inadequate sensitivity for low-level analysis. The claimed specificity of the syringaldazine method for free chlorine disappeared when the method was used in bromide-containing soluions similar to seawater.

43495 (UCRL—50025-79-1, pp 14-17) **Microcomputer-controlled analyzer measures chlorine in water to an accuracy of +-2 ppB.** 30 Mar 1979.

In Electronics engineering department. Quarterly report No. 1, 1979.

The Environmental Protection Agency (EPA) is concerned about how low levels of chlorine in streams and lakes may adversely affect fresh-water trout. Therefore, to accurately measure residual quantities of chlorine, a microcomputer-controlled analyzer was developed that accurately measures chlorine in water to +-2 ppB.

43496 Improvements in the arsine accumulation—helium glow detector procedure for determining traces of arsenic. Feldman, C. (Oak Ridge National Lab., TN). *Anal. Chem.;* **51**: No. 6, 664-669(May 1979).

The convenience and reproducibility of this analytical procedure have been improved, and the time required reduced to 6 minutes per sample, by changing several elements of the procedure. The sample solution is more heavily buffered, gas leakage is prevented, and liquid aerosol is eliminated from the gas stream with an impinger without losing AsH_3. The cold trap is warmed up by a uniform stream of high-velocity air; the newly designed glow chamber prevents coating of the observation window, while giving a detection limit of < or approx. = to 0.1 ng As. The addition of 1 mg ascorbic acid/mL to As solutions prevents spontaneous oxidation of As^{3+} at the 1 to 1000 ppb level at room temperature without reducing any As^{5+}. A procedure is given for eliminating the As^{3+} blank contributed by the buffer solution. 5 figures, 1 table.

43497 Ion flotation of copper using ethylhexadecyldimethylammonium bromide. McDonald, C.; Suleiman, A. (Texas Southern Univ., Houston). *Sep. Sci. Technol.;* **14**: No. 3, 219-225(Mar 1979).

Studies have been undertaken to determine the effect of variables such as pH, flowrate, collector:copper ratio, and chemical interferences in order to develop optimum conditions to remove copper ions from aqueous solutions by ion flotation using ethylhexadecyldimethylammonium bromide (EHDABr). Copper can be removed quantitatively from 6×10^{-5} M solutions containing tartrate using EHDABr over a pH range of 6 to 11. A number of

foreign metallic ions supress the flotation of copper. No foreign ion studied supressed the flotation 10%. 5 tables.

43498 LC-fluorescence measurement of BaP in diesel exhaust. Seizinger, D.E. (Energy Research and Development Administration, Bartlesville, OK). *Trends Fluoresc.;* **1**: No. 1, 9-10(Jan 1978).

In recent years, liquid chromatography (LC) has emerged as a useful analytical tool using either refractive index or uv detectors. However, these continuous monitoring detectors do not have adequate sensitivity and selectivity for low concentration levels of polynuclear aromatic (PNA) compounds. A more sensitive method is needed for these compounds. Some researchers have collected LC fractions and measured these samples using conventional spectrofluorometric techniques for increased sensitivity and selectivity. Typically, this technique has been a time-consuming task requiring solvent compatibility for fluorescence measurement and/or sample concentration subject to analysis. Within the last several years, micro flow-through cells (congruent to 20 μl volume) have been designed and installed in fluorescence instruments for continuous LC monitoring.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 42378, 42446, 43765

43499 (LA—7716) **Quantitative determination of tritium in metals and oxides.** Vance, D.E.; Smith, M.E.; Waterbury, G.R. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

Metallic samples are analyzed for tritium by heating the sample at 1225 K in a moist oxygen stream. The volatile products are trapped and the tritium is quantitatively determined by scintillation spectroscopy. The method is used to determine less than 1 ppb of tritium in 100-mg samples of lithium, iron, nickel, cerium, plutonium, and plutonium dioxide. Analysis of 18 cuts of a tritium-zirconium, copper foil standard over a 3-yr period showed a tritium content of 45 ppM and a standard deviation of 6 ppM.

43500 (LA—7796-PR) **Probes. Progress report, October 1, 1977—September 30, 1978.** Holm, D.M.; Bornhorst, T.J. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 8p. Dep. NTIS, PC A02/MF A01.

Activation analysis with x-ray fluorescence was used to measure the trace element concentrations in samples of boll weevils collected from six different locations. The preliminary results indicate that trace element concentrations are different enough among the six groups to provide a distinctive fingerprint of insects grown in a specific location. These probe experiments have been encouraging enough to warrant further investigation on this concept for identifying the probable origin of specific classes of insects that have been tracked in disease control programs.

43501 (N—79-11169) **The reliability of radiochemical and chemical trace analysis in environmental materials. Ph.d.thesis - Helsinki University.** Heinonen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1977. 102p. NTIS PC A06/MF A01.

The reliability of results of environmental trace analysis is discussed. After theoretically exploring the factors which influence the quality of analytical data as well as the means by which a sufficient quality can be assured and controlled, schemes of different kinds were developed and applied in order to demonstrate the analytical quality assurance and control in practice. Methods were developed for the determination of cesium, bromine, and arsenic by neutron activation analysis at the natural background concentration level in environmental materials. The calibration of methods is described, i.e., their precision, accuracy, and sensitivity were tested and judged from the standpoint of application. The methods were also applied to practical routine analysis, the results of which are briefly reviewed. The results of IAEA's world-wide intercomparison runs from the period 1969 to 1973 are reviewed to survey the present status of environmental trace analysis. The extensive material available makes it possible to conclude that many laboratories are not in a position to be able to control the reliability of their analytical work; the quality of the results is not assured and controlled and is insufficient in relation to what is needed or what is technically feasible. The results of radiochemical analyses in environmental materials show a reliability somewhat better than that occurring in the determination of stable trace elements.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 43493, 43554, 43558, 43733

43502 (CONF-7808102—, pp 9p, Paper 9) **Fuel-burning-efficiency improvements.** Lord, H.C.;Gilbert, L.F. (Environmental Data Corp., Monrovia, CA). Apr 1979.

From Engineering Foundation conference - waste heat utilization; Henniker, NH, USA (13 Aug 1978).

A specialized sensor has been developed to measure portions of a flame's spectra that is related to its air/fuel ratio. One Spectral Flame Analyzer is mounted on each burner of a multi-burner furnace. A closed-loop control system adjusts each burner to the same air/fuel ratio. A second sensor analyzes the flue gases and adjusts the overall excess air to a minimum value to maintain the end point of the flame's chemical reaction to a constant composition. Boiler fuel saving of 2% to 4.5% have been achieved. This savings will pay back the capital investment in one to three years. An automated system that will retrofit to most newer industrial boilers and heaters, which in conjunction with possibly a few additional sensors and control hardware will typically allow continuous operation of natural gas and/or oil-fired units at less than 1% excess oxygen, and coal-fired units at less than 2% excess oxygen is discussed.

43503 (IS-T—856) **X-ray excited optical luminescence of polynuclear aromatic hydrocarbons.** Oestreich, G.J. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 164p. Dep. NTIS, PC A08/MF A01.

X-ray excited optical luminescence (XEOL) coupled with time resolved spectroscopy was employed to analyze polynuclear aromatic hydrocarbons (PAH) in n-alkane solvents at 10 K. A pulsed XEOL system which was designed around minicomputer control of a medical x-ray unit was developed. Computer software which generated variable width x-ray pulses, monitored timing reference pulses, controlled data acquisition, and analyzed data was written. Phosphorescence decay constants of several PAHs were determined. Synthetic mixtures of zone refined PAHs were prepared and time resolved with the pulsed XEOL technique. Analytical results obtained from the five component mixtures of PAHs at the part per million level were tabulated. Systematic improvements and further development of the pulsed XEOL method were considered.

43504 (SAND—79-0709) **Electronic reduction of high speed mass spectral data.** Lee, J.R. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

A window and peak height converter circuit has been designed and built that extracts a single mass peak (or group of peaks) from a set of mass spectra repetitive in time and produces a time profile of that mass. The response time of the circuit is such that one has the capability of real-time operation and of operation on mass spectral data that has been prerecorded on analog tape. The use of analog recording of data allows a great deal of flexibility in recording and playback speeds, and more importantly produces a permanent record of all information contained in the mass spectral data.

43505 Dissociative photoionization of carbon disulphide and carbonyl sulphide. Eland, J.H.D.; Berkowitz, J. (Argonne National Laboratory, Argonne, Illinois 60439). *J. Chem. Phys.;* **70**: No. 11, 5151-5156(1 Jun 1979).

High resolution photoionization mass spectrometry shows that S^+ from CS_2 and COS, and CS^+ from CS_2 appear at the thermochemical dissociation limits with no kinetic or internal energy release to the fragments, accompanied by zero energy electrons. S_2^+ is formed from CS_2 by a bimolecular reaction of CS_2^+(B) of very high cross section, as well as by unimolecular fragmentation. Five new Rydberg series of COS leading to the B and C states are identified, and empirical observations on resonance peak shapes which differ in different channels are presented.

43506 Transition moment for ν_3 of $^{74}GeH_4$. Fox, K.; Halsey, G.W.; Daunt, S.J.; Kennedy, R.C. (The University of Tennessee, Department of Physics and Astronomy, Knoxville, Tennessee 37916). *J. Chem. Phys.;* **70**: No. 11, 5326-5327(1 Jun 1979).

A vacuum grating spectrometer was used to measure the absolute line strength of the vibration-rotation fundamental of GeHy. (AIP)

43507 Structural changes in a sulfur-resistant methanation catalyst as determined from infrared spectra. Stencel, J.M.; Heinz, R.E.; Bradley, E.B. (Department of Electrical Engineering, University of Kentucky, Lexington, Kentucky 40506). *Appl. Spectrosc.;* **33**: No. 2, 118-121(Mar 1979).

The infrared spectrum of a sulfur-resistant $NiO/Cr_2O_3/MgAl_2O_4$ methanation catalyst is presented and compared to the spectra of the catalyst after it was reduced, sulfided, and tested for methanation activity. The molecular structure of the catalyst is shown to be represented by NiO and MgO dispersed in a quasitridimensional Cr: O: Al network. Reducing and sulfiding reorders this network and alters the AlO@sub n@ coordination while reducing Cr^{6+} to Cr^{3+} or Cr^{2+}. The sulfided and methanation-tested catalyst has intense sulfate absorption indicative of sulfur which is coordianted with NiCr and/or NiMg sites.

43508 Collection of gas chromatographic fractions on activated charcoal and identification by infrared spectroscopy. Goldfarb, D.; Brown, C.W. (Department of Chemistry, University of Rhode Island, Kingston, Rhode Island 02881). *Appl. Spectrosc.;* 33: No. 2, 126-130(Mar 1979).

A novel method for collecting gas chromatographic fractions in commercially available tubes of activated charcoal has been developed and tested on a number of organic mixtures. The trapped fractions were desorbed with CS_2 and infrared spectra of the CS_2 solutions measured to provide positive identification of the eluents. The collection efficiency was found to be >68% in all but one case, and the resolution of the separation and collection method was adequate for making positive identifications. The advantages of using computerized subtraction of infrared spectra in identifying the eluents is also demonstrated.

43509 Room temperature phosphorimetry as a new spectrochemical method of analysis. Vo Dinh, T.; Winefordner, J.D. (Univ. of Florida, Gainesville). *Appl. Spectrosc. Rev.;* 13: No. 2, 261-294(1977).

Recent advances in methodology and instrumentation applied to room temperature phosphorimetry are discussed. Analytical figures of merit using the method are discussed. The limitations of the method are also considered. Applications, either published, unpublished, or anticipated, are reviewed. 93 references are cited.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 42218, 42220, 43469, 43569, 43733

43510 (CONF-790415—34) **Demonstration of the potential for designing extractants with preselected extraction properties: possible application to reactor fuel reprocessing.** Mason, G.W.; Griffin, H.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 25p. Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

From the knowledge of the extractant characteristics of both neutral and mono-acidic phosphorus-based organic compounds now available, it is possible to tailor-make extractants for a specifically desired separation of two metals. The present study is concerned with neutral mono-nuclear, phosphorus-based extractants for use in affecting the mutual separation of U(VI) and Th(IV).

43511 (IS-T—851) **Analysis of backmixing and mass transfer in solvent extraction columns.** Nazem, M. (Ames Lab., IA (USA)). Jan 1979. Contract W-7405-ENG-82. 155p. Dep. NTIS, PC A08/MF A01.

A critical survey of the published literature concerning modelling of liquid-liquid extraction columns, mass transfer studies in extraction towers and the influence of backmixing on concentration profiles, extraction efficiency and the number of transfer units has been made to determine the most accurate correlations for computing the true number of transfer units or the true overall mass transfer coefficients in backmixed solvent extraction columns. These parameters are of great significance and are very useful in the design and performance evaluation of solvent extraction columns. Several approximate correlations of these parameters as a function of column geometry, operating conditions, and physical properties of the liquid systems involved have been developed and it is possible to use mathematical models in the interpretation and analysis of experimental data to determine which correlations appear to be most accurate and easiest to use. The results of the data analysis, together with the best possible estimate of the extraction efficiency were applied to a differential backmixing model to obtain concentration profiles in an extraction column.

43512 (IS-T—855) **Chromatography of metal ions with a triazine chelating resin.** Wang, W.N. (Ames Lab., IA (USA)). May 1979. Contract W-7405-ENG-82. 65p. Dep. NTIS, PC A04/MF A01.

Thesis.

The synthesis, characterization, and some analytical applications of a new triazine resin are described. Separation of group IB, IIB, VIB, and VIIB metal ions from group VIII metal ions is achieved by this PDT-4 resin. Calcium(II) and magnesium(II) are taken up at pH = 6, 0.1 M acetate and are eluted at pH = 6, 0.1 M sodium nitrate. Copper(II) is retained at pH = 6, 0.1 M acetate and pH = 1 hydrochloric acid and is eluted subsequently by 5 M perchloric acid. Molybdenum(VI) is sorbed selectively from 0.1 N sulfuric acid or hydrochloric acid and is eluted in a tight band by 0.1 N sodium hydroxide. Numerous rapid column chromatographic separations are reported using this new resin, including analysis of NBS standard samples.

43513 (UCRL—81374) **Neptunium(V) anionic exchange in sulfate-sulfuric acid solutions.** Rego, J.; Garrison, J.; Carver, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 May 1979. Contract W-7405-ENG-48. 5p. (CONF-790415—33). Dep. NTIS, PC A02/MF A01.

From 177. ACS national meeting; Honolulu, HI, USA (1 Apr 1979).

The purpose of this study was to investigate the anionic exchange behavior of neptunium(V) in sulfate-sulfuric acid, because neptunium is often present as a contaminant during the separation of other actinides. Sulfuric acid systems are seldom utilized in industrial processes, but are often used as part of a laboratory analytical procedure. Literature on neptunium in $HClO_4$, HCl, HCl—HF, and HNO_3 is quite complete, but the information on the H_2SO_4 system is sketchy at best. There is one report (L. Wish and M. Rowall, USNROL-TR-117, 1956) that neptunium(V) is adsorbed strongly on Dowex 2 resin from 0.1 N to 1 N H_2SO_4. Our measurements indicate that there is very little adsorption of Np(V) on Dowex 1 resin even at low concentrations of sulfate-sulfuric acid. We believe the differences in chemical structure of the two resins are not sufficient to explain the disparity in adsorption.

43514 Extraction of metals by bis-(2-ethylhexyl) phosphoric acid in 2-ethylhexanoic acid as monomerizing diluent from an aqueous chloride phase: Th(IV) and U(VI). Mason, G.W.; Lewey, S.M.; Peppard, D.F. (Argonne National Lab., IL (USA)). *J. Inorg. Nucl. Chem.;* 40: No. 7, 1427-1430(1978).

The extraction of Th^{4+} and UO_2^{2+} from an aqueous phase into a solution of bis 2-ethylhexyl phosphoric acid, $(2\text{-}C_2H_5.C_6H_{12}O)_2$ PO(OH), HDEHP, in the monomerizing diluent 2-ethylhexanoic acid has been studied in terms of the concentration of hydrogen ion in the equilibrated aqueous phase and of HDEHP in the opposing equlibrated organic phase. The extraction stoichiometries, with the corresponding expression for K in terms of F (the formality of HDEHP in the organic phase), $[H^+]$ (the concentration of hydrogen ion in the aqueous phase), and Ksub(S), for a 1.00 F (NaCl + HCl) aqueous phase, are: $Thsub(A)^{4+} + 5HY_0 = Th(HY_5)_0 + Hsub(A)^+$ $(K = Ksub(S)F^5/[H^+]^4)$; and $UOsub(2A)^{2+} + 3HY_0 = UO_2(HY_3)_0 + 2Hsub(A)^+$ $(K = Ksub(S)F^3/[H^+]^2)$, where Hy represents the monomer HDEHP and the formulations of extracted species are non committal with respect to structure. With HZ representing the monomer of 2-ethylhexanoic acid, suggested formulations of the extracted species in terms of homogeneous and heterogeneous dimers are: $Th(HY_2)(HYZ)_3$ and $UO_2(HY_2)(HYZ)$. The Ksub(S) values are: Th^{4+} (7×10^4) and UO_2^{2+} (2×10^2). Comparison of the extraction of Th^{4+} and UO_2^{2+} with the extraction, previously reported, of Am^{3+}, Eu^{3+}, Tm^{3+} and Y^{3+} in the same system is made. Application (patented) of this liquid-liquid extraction system to the purification of thorium from contaminant rare earths and yttrium is demonstrated.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 42504, 42510, 43394, 43420, 43535, 43541, 43548, 43567

43515 (IS-M—209) **Preparation and purification of $GdCl_3$.** Kim, Y.S.; Planinsek, F.; Beaudry, B.J.; Gschneidner, K.A. Jr. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 6p. (CONF-790641—3). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

$GdCl_3$ has been prepared from high purity Gd_2O_3 with NH_4Cl as the chlorinating agent. The optimum time, temperature, air flow rate, and the mixing ratio of Gd_2O_3 and NH_4Cl for chlorination were determined. Almost complete conversion (99.8%) of Gd_2O_3 to $GdCl_3$ was obtained with 2.5 times or more the theoretical amount of NH_4Cl and with at least a 20 hr reaction time at 250°C under a dried air flow. The excess NH_4Cl was removed from the $GdCl_3$ by sublimation at 350°C in vacuum. The resulting $GdCl_3$ was purified to a dense crystalline $GdCl_3$ by distillation in vacuum using Ta crucibles and condensers.

43516 (KFK-EXT—10/78-1) **Literature survey on the determination, properties and removal methods of ozone.** Penzhorn, R.D.; Noppel, H.E.; Guenther, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Jul 1978. 59p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

During operation of nuclear facilities where ozone can get formed by radiation impact on oxygen or oxygen compounds, an increased safety hazard can be anticipated. This problem is the main concern of the literature compilation presented here. Particular attention was given to work performed at low temperatures because under these conditions an enrichment of liquid oxygen, often associated with an enhanced ozone concentration, frequently occurs. Emphasis was given to reactions of ozone with hydrocarbons and certain inorganic compounds known to have explosive character. The bibliography has been extended by a few of the recently greatly increased number of publications related to the chemistry of ozone in

the atmosphere and stratosphere. A major portion of the compilation consists in references about the physical and chemical properties of ozone as well as its formation (especially by radiochemical processes), explosive behavior, destruction or removal and analytics.

43517 (LA—7774-T) **Kinetics and thermodynamics of nickel (II): glycine complexes using carbon magnetic resonance.** Shepard, D.F. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 234p. Dep. NTIS, PC A11/MF A01.

Thesis.

l-^{13}C glycine was studied in nickel(II) solutions using carbon magnetic resonance (CMR). The carboxy bound nickel(II)-glycine complex and the kinetics of complexation between aquated nickel(II) ion and aquated glycine are described. It has been hypothesized that solutions containing no complexation higher than the chelated mono nickel(II)-glycine complex contain five magnetically different glycine species. The lifetime of the carboxy bound complex is 7.87 x 10^{-4} at 272°K with an activation energy of 9.74 kcal/mole, an activation enthalpy of 9.15 kcal/mole at 298°K, an Arrhenius frequency factor of 8.33 x 10^{10} s^{-1}, and an activation entropy of -10.6 cal/mole-deg K. The upfield resonance is attributed mainly to the bidentate or chelated complex. The activation enthalpy for the dissociation of the chelated mono complex is 14.4 kcal/mole. The hyperfine interaction constant, A/h, for this upfield resonance is 5.2 x 10^5 s^{-1} and the linewidth broadening is primarily due to a dipolar relaxation mechanism. CMR resonances for all carbons in the unassociated glycine, the mono, bis, and tris complexes, and in the glycine analogues, betaine hydrochloride, ethylglycinate hydrochloride, and betaine ethylester chloride are reported. The resonances for the meridional and facial isomers of the tris complex are discussed. Some preliminary data on mixed complexes of nickel(II), glycine, and ethylenediamine are reported.

43518 (LBL—8975, pp 18-19) **Surface structure from photoelectron spectroscopy.** Shirley, D.A. (Univ. of California, Berkeley). Feb 1979.

In Heterogeneous catalysis research meeting.

43519 (LBL—8975, pp 31-32) **Catalysis and surface studies of high density of states materials.** Brodsky, M.B.; Bader, S.D. (Argonne National Lab., IL). Feb 1979.

In Heterogeneous catalysis research meeting.

43520 (LBL—8975, pp 62-63) **Measurement of forces in adsorption.** Taylor, E.H. (Oak Ridge National Lab., TN). Feb 1979.

In Heterogeneous catalysis research meeting.

43521 (RFP—2878) **Decomposition kinetics of plutonium hydride.** Haschke, J.M.; Stakebake, J.L. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 6p. (CONF-790641—1). Dep. NTIS, PC A02/MF A01.

From Rare earth research conference; Fargo, ND, USA (25 Jun 1979).

Kinetic data for decomposition of $PuH_{1.95}$ provides insight into a possible mechanism for the hydriding and dehydriding reactions of plutonium. The fact that the rate of the hydriding reaction, K/sub H/, is proportional to P/sup 1/2/ and the rate of the dehydriding process, K/sub D/, is inversely proportional to P/sup 1/2/ suggests that the forward and reverse reactions proceed by opposite paths of the same mechanism. The P/sup 1/2/ dependence of hydrogen solubility in metals is characteristic of the dissociative absorption of hydrogen; i.e., the reactive species is atomic hydrogen. It is reasonable to assume that the rates of the forward and reverse reactions are controlled by the surface concentration of atomic hydrogen, [H/sub s/], that K/sub H/ = c'[H/sub s/], and that K/sub D/ = c/[H/sub s/], where c' and c are proportionality constants. For this surface model, the pressure dependence of K/sub D/ is related to [H/sub s/] by the reaction [H/sub s/] reversible 1/2H_2(g) and by its equilibrium constant K/sub e/ = [H_2]/sup 1/2// [H/sub s/]. In the pressure range of ideal gas behavior, [H/sub s/] = K/sub e/$^{-1}$(RT)/sup -1/2/ and the decomposition rate is given by K/sub D/ = cK/sub e/(RT)/sup -1/2/P/sup 1/2/. For an analogous treatment of the hydriding process with this model, it can be readily shown that K/sub H/ = c'K/sub e/$^{-1}$(RT)/sup -1/2/P/sup 1/2/. The inverse pressure dependence and direct temperature dependence of the decomposition rate are correctly predicted by this mechanism which is most consistent with the observed behavior of the Pu—H system.

43522 **Reactions of the difunctional organochromium cation 3,3'-oxybis[(chromiomethyl)benzene](4+), ($CrCH_2C_6H_4)_2O^{4+}$.** Marty, W.; Espenson, J.H. (Ames Lab., IA). *Inorg. Chem.;* **18**: No. 5, 1246-1250(May 1979).

The title compound, I, was prepared from bis[m-(bromomethyl)phenyl] ether and excess chromium(II) in aqueous acetone. The product was purified by ion-exchange chromatography, and its composition was verified from its spectrum and from the products obtained on base hydrolysis and on reaction with mercury(II) and mild oxidants. Reaction of the dibromide with limiting quantities of chromium(II) produces the complex $[CrCH_2C_6H_4OC_6H_4CH_2Br]^{2+}$ (II) which was similarly characterized. Kinetic data were obtained on the reactions forming I and II and on the reactions of I and II with mercury(II) ion. The data are intepreted to show that the difunctional materials react at about twice the rate of their monofunctional analogues, suggesting little important neighboring group assistance. Reactions known to occur in (at least) two stages having comparable rates occasionally give evidence of but a single kinetic step; some general statements relating to statistically related biphasic kinetic schemes are given.

43523 **Unusual charge distributions in some bis(fulvalene)dimetal complexes as revealed by X-ray photoelectron spectroscopy.** Bakke, A.A.; Jolly, W.L.; Pinsky, B.L.; Smart, J.C. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 5, 1343-1345(May 1979).

A series of bis(fulvalene)dimetal species, [($C_{10}H_8)_2M_2$]/sup n+/, was studied by using X-ray photoelectron spectroscopy. Some of the complexes have metal binding energies which are lower than one would expect, assuming the ligands to be dianions. These data are rationalized by considering the metal atoms to be in reduced oxidation states and the fulvalene ligands to be partially oxidized. The metal 2p spectra of the mixed-valence compounds (n=1) of cobalt and nickel show line broadening indicative of two inequivalent core-ionized states. Most of the paramagnetic compounds show an increase in spin-orbit splitting and line broadening attributable to multiplet splitting. Satellite structure, arising from ligand-to-metal charge-transfer transitions, appears in the spectra of some of the paramagnetic compounds.

43524 **Oxygen transfer in the reactions of hypofluorous acid with aqueous solutions.** Appelman, E.H.; Thompson, R.C.; Engelkemeir, A.G. (Argonne National Lab., IL). *Inorg. Chem.;* **18**: No. 4, 909-911(Apr 1979).

Oxygen-18 tracer studies have shown that the reactions of HO*F with H_2O and with aqueous HSO_4^- and $Cr(NH_3)_5N_3^{2+}$ lead to transfer of oxygen with formation of HOO*H, $O_3SOO^*H^-$, and $Cr(NH_3)_5NO^{*2+}$, respectively. Transfer is incomplete in the case of dilute (0.4 M) bisulfate solutions.

43525 **Simplified in situ syntheses of anhydrous $HMn(CO)_5$.** Gladysz, J.A.; Tam, W.; Williams, G.M.; Johnson, D.L.; Parker, D.W. (Univ. of California, Los Angeles). *Inorg. Chem.;* **18**: No. 4, 1163-1165(Apr 1979).

Three rapid, convenient procedures are reported for the in situ preparation of anhydrous $HMn(CO)_5$ in tetrahydrofuran (THF). Protonation of Li[$Mn(CO)_5$] in situ previously prepared by the reaction of $Mn_2(CO)_{10}$ with $Li(C_2H_5)BH$ in THF yielded $HMn(CO)_5$ which was contaminated by (C_2H_5) from the preparation and by $Li^+CF_3SO_3^-$ from the protonation reaction by trifluormethanesulfonic acid (CF_3SO_3H). $HMn(CO)_5$ free from $(C_2H_5)_3B$ can be prepared by volatilizing the $(C_2H_5)_3B$ along with the solvent, or alternately, the $[Mn(CO)]^-$ can be isolated as its crystalline μ-nitrido-bis-(triphenylphosphorous) salt. The in situ synthesis of $HMn(CO)_5$ free from ionic byproducts was accomplished by the solvolysis in methanol of $(CH_3)_3Si[Mn(CO)_5]$.

43526 **Polymer-anchored palladium(II) complexes as catalysts for the conversion of quadricyclane to norbornadiene.** King, R.B.; Hanes, R.M. (Univ. of Georgia, Athens). *J. Org. Chem.;* **44**: No. 7, 1092-1094(30 Mar 1979).

Reaction of diphenylphosphinated macroreticular polystyrene with $(CH_3CN)_2PdCl_2$ gives a polymer-supported palladium(II) chloride which is an active catalyst for the conversion of quadricyclane to norbornadiene. However, the activity of this catalyst is less by factors of 2-85 than that of the soluble catalyst $[(C_6H_5)_3P]_2PdCl_2$. The new polymer-supported palladium catalyst, like previously reported polymer-supported catalysts for this reaction, loses some of its activity upon repeated recycling. 1 table.

43527 **Spin—orbit coupling in metal—anion systems. The colors of post-transition metal salts.** Carsey, T.P.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge). *J. Am. Chem. Soc.;* **101**: No. 7, 1728-1733(28 Mar 1979).

A configuration-mixing model is developed for spin—orbit coupling in metal salts. The component excited configurations are of locally excited (LE) or charge transfer (CT) varieties. It is shown that the triplet /reverse arrow/singlet ($^1_1$/reverse arrow/S_0) transition of the nominal anion steals its intensity from local excitations in the case of light nontransition metal salts (e.g., $NaNO_2$) and from charge-transfer excitations in the case of heavy post-transition metal salts (e.g., $AgNO_2$). The model provides a simple rationalization of the colors and luminescences of post-transition metals in which neither the anion nor cation is separately chromophoric.

43528 Shock tube measurements of rate coefficients of elementary gas reactions. Bowman, C.T.; Hanson, R.K. (Stanford Univ., CA). *J. Phys. Chem.;* **83**: No. 6, 757-763(22 Mar 1979).

The primary objective of this paper is to review the current status of rate coefficient determinations of elementary gas reactions using modern shock tube measurement technques. The major inaccuracies in these determinations arise from uncertainties in reaction conditions due to gas dynamic effects, uncertainties introduced by interfering rate processes such as vibrational relaxation, competing reactions, or reactions involving impurities, and uncertainties introduced by the diagnostics. Some new diagnostics and experimental methods which can improve accuracy of shock tube rate coefficient measurements are discussed. Included among these are tunable laser absorption spectroscopy for species concentration and temperature measurements, digital data recording, new techniques for controlled generation of radical species, and computer optimization of experimental conditions. Currently attainable levels of accuracy of shock tube rate coefficient determinations of elementary gas reactions are illustrated for several classes of reactions including unimolecular decomposition reactions, bimolecular atom—molecule exchange reactions, and termolecular recombination reactions. 5 figures, 1 table.

43529 Neutral metal formyl complexes: generation, reactivity, and models for Fischer—Tropsch catalyst intermediates. Tam, W.; Wong, W.K.; Gladysz, J.A. (Univ. of California, Los Angeles). *J. Am. Chem. Soc.;* **101**: No. 6, 1589-1591(14 Mar 1979).

Several metal formyl complexes were prepared by reacting $Li(C_2H_5)_3BH$ with metal carbonyl cations containing manganese, rhenium, iridium, and molybdenum. Preparative conditions, percentage yields, thermal stabilities, and ^1H NMR chemical shifts relative to $(CH_4)_4Si$ are given for several of the products. Over the course of ten minutes the reaction of $HMn(CO)_5$ and $HMo(C_5H_5)(CO)_3$ resulted in the formation of $Mn(CO)_{10}$ and benzaldehyde. The compounds are used to illustrate the types of intermediates which may be initially formed in Fischer—Tropsch type synthesis. 1 table, 1 scheme.

43530 Three isomers of the Al—C_2H_3 system. Trenary, M.; Casida, M.E.; Brooks, B.R.; Schaefer, H.F. III. (Univ. of California, Berkeley). *J. Am. Chem. Soc.;* **101**: No. 6, 1638-1639(14 Mar 1979).

Self-consistent field (SCF) wave functions were computed for several electronic states of each of the three isomers. The π-bonded Al—C_2H_2 and Al—C_2H_4 dissociation energies are expected to be $\leq$ 5 kcal/mol, even though effects of extensive configuration interaction and aluminum d functions were explicitly considered. The equilibrium geometries of the σ-bonded and vinylidine complexes are illustrated. At the SCF level of theory the σ complex is bound by 8.0(trans) or 8.2(cis) kcal, while the vinylidine complex is bound by 21.5 kcal relative to infinitely separated aluminum + acetylene. Configuration interaction including all valence electron single and doublet excitations reduces the dissociation of the vinylidine complex to ca 20 kcal for the Al—CCH_2 bond energy. The shorter Al—C internuclear separation for the vinylidine complex also attests to its stronger Al—C bond. Analogous studies of the trans-σ-bonded yield a binding energy of 7.5 kcal. The vinylidine structure is inconsistent with another author's previously published ESR spectrum, apparently because of reaction temperature. 1 figure.

43531 Comparison of the rates of electron exchange reactions of ammine complexes of ruthenium(II) and -(III) with the predictions of adiabatic, outer-sphere electron transfer models. Brown, G.M.; Sutin, N. (Brookhaven National Lab., Upton, NY). *J. Am. Chem. Soc.;* **101**: No. 4, 883-892(14 Feb 1979).

The rate constants for the Ru(NH3)6/sup 3+/2+/, Ru(NH3)4(bpy)/sup 3+2+/, and Ru(NH3)2(bpy)2/sup 3+/2+/ electron exchange reactions have been measured by a technique involving subtle modifications of the ligands. The rate constants ($M^{-1}s^{-1}$, medium) at 25°C are 3.2 x 10^3, 0.1 M CF_3SO_3H, for the Ru(NH3)6/sup 3+/2+/ exchange; 7.7 x 10^5, 0.1 M CF_3SO_3H, and 2.2 x 10^6, 0.1 M $HClO_4$, for the Ru(NH3)4(bpy)/sup 3+/2+/ exchange; 8.4 x 10^7, 0.1 M $HClO_4$, for the Ru(NH3)2(bpy)/sup 3+/2+/ exchange. The rate constants and activation parameters for the Ru(NH3)4(bpy)/sup 3+/2+/ exchange reaction were determined as a function of ionic strength (k = 4.1 x 10^4 $M^{-1}s^{-1}$, ΔH is not equal to 4.0 kcal mol^{-1}, and ΔS is not equal to -24 cal deg^{-1} mol^{-1} at zero ionic strength and 25°C). The rate constants determined in this work together with those for the analogous Ru(NH3)5py/sup 3+/2+/ and Ru(bpy)3/sup 3+/2+/ exchange reactions are compared with the predictions of theoretical models. Good linearity was found for a plot of log k/sub ex/ vs. 1/anti r, where anti r is the mean separation of the ruthenium centers in the activated complex. The Marcus model derived on the basis of a reactive collision formulation gives better agreement with the observed rate constants and activation parameters at zero ionic strength than the conventional ion-pair preequilibrium model. Contrary to prediction, the increase in exchange rate with increasing ionic strength is reflected primarily in a decreased enthalpy of activation. 6 figures, 5 tables.

43532 Some reactions of the perbromate ion in aqueous solution. Appelman, E.H.; Klaening, U.K.; Thompson, R.C. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **101**: No. 4, 929-934(14 Feb 1979).

The reaction of the perbromate ion with a number of two-equivalent reductants have been studied in aqueous solution at an ionic strength of approximately one. Reaction rates increase in the order $N_3^- < ClO_2^-$ approx. SeO_3^{2-} approx. $NO_2^- < P(III) << S(IV) \leq As(III) < Sb(III)$. The perbromate-sulfur(IV) reaction obeys the rate law -d[BrO_4^-]/dt = k/sub S/[BrO_4^-][SO_3^{2-}] in solutions more basic than pH 4.5. At 25°C, k/sub S/ = 5.8 x 10^{-3}L/mol.s. The perbromate-arsenic(III) reaction obeys the rate law -d[BrO_4^-]/dt = $[(k_1[H^+] + k_2K_1 + k_3K_1/[H^+])/(K_1 + [H^+])][BrO_4^-][As(III)]$. At 39.7°C, k_1 = 5.6 x 10^{-4}L/mol.s, k_2 = 1.96 x 10^{-2}L/mol.s:k_3 = 1.16 x $10^{-12}s^{-1}$, and K_1 = 1.6 x 10^{-9}M. This rate law can be interpreted in terms of increasing reactivity of the species H_3AsO_3, $H_2AsO_3^-$, and $HAsO_3^{2-}$ toward perbromate. In strong base, the perbromate-antimony(III) reaction obeys the rate law -d[BrO_4^-]/dt = k/sub Sb/ [BrO_4^-][Sb(III)],where k/sub Sb/ = 0.47 L/mol.s at 25°C. Activation parameters were determined for the sulfur(IV), arsenic(III), and antimony(III) reactions, and the dependences of the S(IV) and As(III) reactions on total salt concentration were elucidated. The results of isotopic tracer studies show that in its reactions with S(IV) and As(III) the perbromate ion transfers one of its oxygen atoms to the reductant. Oxygen exchange between 0.14 M $KBrO_4$ and water proceeded to less than 7% of completion in the course of 19 days at 94°C, in solutions ranging from 0.06 M acid to 0.02 M base. The implications of all of these results are discussed. 7 tables, 1 figure.

43533 Unipolar aerosol diffusion charging. II. Ion and aerosol polydispersites: the diffusion charging mobility analysis hypothesis. Marlow, W.H. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Colloid Interface Sci.;* **64**: No. 3, 549-554(May 1978).

Macroscopically realizable charging conditions are discussed. The equations for time-dependent unipolar polydisperse aerosol charging by polydisperse ions are first solved for the cases of a constant ionic generation rate of 10 ions/cm^3/sec with ionic removal by diffusion from the charging volume of 1 cm^3 by aerosol capture. In the second case, the equations are used in the modeling of the charging and mobility spectrum analysis of the electrical aerosol analyzer (Thermo Systems, Inc., St. Paul, MN) as an example of the diffusion charging mobility analysis procedure for aerosol size distribution analysis. Due to ion polydispersity, it is shown for the instrument's lower channels that an ambiguity of at least 50% in the raw data exists for the measurement of free-molecular and transition regime particles by this procedure.

43534 Unipolar aerosol diffusion charging. I. Particle dielectric constant and ion mobility distribution effects. Marlow, W.H. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Colloid Interface Sci.;* **64**: No. 3, 543-548(May 1978).

The equations of unipolar aerosol charging are written to include ion polydispersity. It is shown that the frequently used N0/sup t/ parameterization of aerosol charging is not unique but can be replaced by a Ct (C = conductivity) parameterization which is for slip-flow and continuum regime spherical particles of uniform composition. The equations are simplified for the monodisperse unipolar case and, by choosing polydisperse ion distributions which are representative of realistic atmospheric ions, the sensitivity of aerosol charging to specific ion distributions is illustrated. The role of the particle dielectric constant in aerosol charging is assessed.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 43387

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 42371

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 42509, 42510, 43522, 43526, 43529, 43563

43535 (COO—1198-1249) NMR studies of liquids and disordered solids at high pressure. Fury, M.A. (Illinois Univ., Urbana (USA)). 1978. Contract EY-76-C-02-1198. 166p. Dep. NTIS, PC A08/MF A01.

Thesis.

Molecular reorientation and translation in molecular liquids was studied. A dominant premise in these studies was that, except in strongly hydrogen-bonded systems such as water, the dynamics of a

liquid may be considered to be a series of impulsive collisions. Details of the behavior would be dominated by the shape and size of the molecules under constant packing conditions. The second area of effort was in the plastic crystalline solid phase of two globular molecules, adamantane and cyclohexane. The NMR technique was used in these studies to measure self-diffusion coefficients and spin-lattice relaxation times. The applicability of pulsed NMR techniques to the study of the kinetics of order—disorder phase transitions in solid adamantane was demonstrated.

43536 (EPRI-ER—1034) **Experimental enthalpies for a mixture of 80 mole percent isobutane in isopentane. Final report.** Koppany, C.R.; Lenoir, J.M. (Braun (C.F.) and Co., Alhambra, CA (USA)). Mar 1979. 52p. Dep. NTIS, PC A04/MF A01.

Seven enthalpy isobars were measured for a nominal mixture of 80% isobutane/20% isopentane. These data were used to construct a phase envelope for use in the design of a turbine expander and the heat exchangers for a geothermal power plant. The dew point values for the phase envelope are difficult to establish for a mixture, particularly in the region near the critical.

43537 (UCRL—82332) **^{35}Cl and ^{81}Br nuclear magnetic resonance studies of carbonic anhydrase.** Ward, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1979. Contract W-7405-ENG-48. 25p. (CONF-790439—1). Dep. NTIS, PC A02/MF A01.

From Symposium on biophysics and physiology of carbon dioxide; Regensburg, F.R. Germany (17 Apr 1979).

^{35}Cl NMR studies substantiated the binding of Cl^- to the Zn(II) of carbonic anhydrase. Zinc-free carbonic anhydrase was prepared and it exhibited essentially no effect on the Cl^- line width. The net Cl^- line width increased with temperature. ^{81}Br NMR was quite similar to ^{35}Cl in that its relaxation is dominated by quadrupolar interactions.

43538 Collisionless nonradiative decay rates of single rotational levels of S_1 formaldehyde. Weisshaar, J.C.; Moore, C.B. (Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **70**: No. 11, 5135-5146(1 Jun 1979).

Fluorescence lifetimes of single rotational levels of the lowest vibrational level of the first excited singlet state of H_2CO and D_2CO have been measured under collision-free conditions following excitation by a pulsed dye laser. For H_2CO, the lifetimes range from 66 ns to 4.2 μs with a median of about 160 ns. Individual lifetimes show no systematic variation with J', K', or E@sub rot@. K-doublet levels split by as little as 8 x $10^{-4}cm^{-1}$ in S_1 are observed to have different lifetimes. The H_2CO results are interpreted in terms of a sequential coupling model ($S_1 \rightarrow S_0 \rightarrow$continuum) in which the final states are those of the H_2+CO dissociation continuum. For D_2CO, the lifetimes vary between 5.5 and 8.1 μs and are nearly radiative lifetimes.

43539 Electron spin resonance studies of barriers to hindered rotation in acetic acid, acetamide, and peptide radicals. Suryanarayana, D.; Sevilla, M.D. (Oakland Univ., Rochester, MI). *J. Phys. Chem.;* **83**: No. 10, 1323-1327(17 May 1979).

Activation energies for methyl group rotation in the radicals of type $H_3C\text{-}C<$, produced from acetic acid, acetamide, and peptides, have been found by using ESR techniques. Reactions of electrons at 77 K with acetic acid and acetamide in 12 M LiCl (D_2O) as well as in 8 M NaOD glasses have produced the acetic acid anion, the acetate dianion, and the acetamide anion. ESR spectra of these have revealed a doublet (ca. 32G) at 90 K reversibly interconverting to a 1:3:3:1 quartet, of ca. 15-G hyperfine splitting, at higher temperatures (170 K). This interconversion has been attributed to the hindered internal rotation of the methyl group about the $H_3C\text{-}C<$ bond. The ESR spectra are analyzed using modified Bloch equations for the three-jump process. The mean lifetime (tau) at each temperature (T) has been estimated by a comparison of experimental and simulated ESR spectra. The activation energy (E/sub a/) for the sixfold barrier to the rotation is found to be 5.0 +- 0.5 kcal/mol in the acetate dianion and is about 3.0 kcal/mol for the acetate and acetamide as well as N-acetylamino acids. ESR spectra characteristic of the tunneling methyl group were observed at low temperature ($20\ K < T < 100K$) for the radicals produced in γ-irradiated polycrystalline samples of glycyl-L-alanine and L-alanyl-L-alanine. 3 figures, 1 table.

43540 Effect of strongly bound oxygen on the dehydrogenation and hydrogenation activity and selectivity of platinum single crystal surfaces. Smith, C.E.; Biberian, J.P.; Somorjai, G.A. (Univ. of California, Berkeley). *J. Catal.;* **57**: No. 3, 426-443(May 1979).

The dehydrogenation of cyclohexene and cyclohexane, and the hydrogenation of cyclohexene were studied on the clean and preoxidized surfaces of three platinum single crystals—a Pt(111), a stepped Pt(S)-[6(111) x (100)] and a kinked Pt(S)-[7(111) x (310)]—at low pressure (10^{-6} to 10^{-5} Torr total pressure), at 150°C. Oxygen coverages were monitored by Auger electron spectroscopy (AES); the surface structures of the clean and oxidized platinum crystals were determined by low-energy electron diffraction (LEED). Low coverages of strongly bound oxygen enhanced the rates of the dehydrogenation and hydrogenation reactions, and changed the selectivity of cyclohexene dehydrogenation to benzene over hydrogenation to cyclohexane. These effects of preoxidation on catalytic rates and selectivity were found to be sensitive to the structure of the platinum surface, kink sites playing a particularly active role in the enhancement of dehydrogenation and hydrogenation activity by strongly bound oxygen. Three models are discussed which relate the oxidation of platinum surfaces to the observed effects on catalytic activity and the structure sensitivity. A change in the electronic structure of the platinum surface through oxidation provides the best general model for explaining the oxygen effects, though complex formation involving the adsorbed oxygen or surface reconstruction during oxidation may also be important.

43541 Synthesis of cyclopentadienyldicarbonyl(dithiocarbene)iron cations and their reactions with amines. McCormick, F.B.; Angelici, R.J. (Ames Lab., IA). *Inorg. Chem.;* **18**: No. 5, 1231-1235(May 1979).

Dithiocarbene complexes, $Cp(CO)_2Fe[C(SR)SR']^+$, are easily prepared by $R'SO_3F$ alkylation of the dithioester ligand of $Cp(CO)_2FeC(=S)SR$. The dimethyl derivative, $Cp(CO)_2Fe[C(SCH_3)_2]^+$, shows unusual reactivity toward nucleophilic amines to provide a variety of $Cp(CO)_2FeL^+$ derivatives. Primary amines produce isocyanide complexes, $Cp(CO)_2Fe(CNR)^+$; secondary amines give amino-thiocarbene complexes, $Cp(CO)_2Fe[C(NR_2)SCH_3]^+$; diamines, amino alcohols, and amino thiols yield complexes with cyclic carbene ligands, $Cp(CO)_2Fe[CY(CH_2)/sub\ n/NR']^+$, where Y = NH, O, or S. The novel orthothioformate complex $Cp(CO)_2Fe[C(SCH_3)_3]$is formed as a byproduct in some of the reactions. Spectral properties of the new complexes are discussed.

43542 Intramolecular photochemical cycloaddition of a vinylogous imide. Crystal and molecular structure of a tetracyclic $C_{17}H_{25}O_2N$ product. Schell, F.M. (Univ. of Tennessee, Knoxville); Cook, P.M.; Hawkinson, S.W.; Cassady, R.E.; Thiessen, W.E. *J. Org. Chem.;* **44**: No. 9, 1380-1382(27 Apr 1979).

Pyrex-filtered irradiation of N-acetyl-3-(N-cyclohexenylmethyl)amino-5,5-dimethyl-2-cyclohexen-1-one (1) provides an acyl migration product and an intramolecular cycloaddition product. The cycloaddition reaction was shown to be thermally reversible. The structure of the tetracyclic product was inferred from chemical and spectroscopic data, and the stereochemistry was fully defined via X-ray crystal-structure analysis. Crystal data (from single-crystal diffractometry, Mo $K\alpha_1, \lambda = 0.70926$ A, at T = 20 +- 1°C): a = 20.815 (8), b = 10.875 (2), c = 6.625 (1) A; $P2_12_12_1$, Z = 4; d/sub c/ = 1.218 and d/sub o/ = 1.19 g cm^{-3} by flotation in NaBr solutions; f(000) = 600. 1 figure.

43543 (Triphenylcyclopropenyl) nickel derivatives as catalysts for the isomerization of quadricyclane to norbornadiene. King, R.B.; Ikai, S. (Univ. of Georgia, Athens). *Inorg. Chem.;* **18**: No. 4, 949-954(Apr 1979).

Infrared spectroscopy indicates that the (triphenylcyclopropenyl) nickel complex $(C_6H_5)_3C_3Ni(CO)Cl$ readily loses its CO ligand in solution at room temperature but reacts with CO at room temperature and atmospheric pressure to form successively $(C_6H_5)_3C_3Ni(CO)_2Cl$ and $Ni(CO)_4$. Reactions of $(C_6H_5)_3C_3Ni(CO)Cl$ with various ligands in solution at room temperature rapidly give complexes with a L:Ni ratio of 2:1 of the type $(C_6H_5)_3C_3NiL_2Cl$ (L = tetrahydrofuran, 2,2'-bipyridyl, $(C_6H_5)_2PCH_3$, $(C_6H_5)_2PCl$, $C_6H_5PCl_2$, and $P(OR)_3$ (R = Phenyl, isopropyl, and methyl)). The ligand $(C_6H_5)_2PCH_3$ also gives an isolable 1:1 L—Ni complex of the stoichiometry $(C_6H_5)_3C_3Ni[P(C_6H_5)_2CH_3]Cl$. The complex $(C_6H_5)_3C_3Ni(CO)Cl$ is an active catalyst for the isomerization of quadricyclane to norbornadiene under conditions where it is converted to a carbonyl-free complex. Addition of the ligands L to $(C_6H_5)_3C_3Ni(CO)Cl$ in L:Ni ratios from 1:1 to 3:1 gradually reduces the catalytic activity of these systems. The catalytic activities of the $(C_6H_5)_3C_3NiL_2Cl$ derivatives (L = trivalent phosphorus ligand) increase as the coordination chemical shift decreases in their phosphorus-31 NMR spectra.

43544 Ionic hydrogenations using $BF_3.OH_2$. Reductions of polycyclic aromatics. Larsen, J.W. (Oak Ridge National Lab., TN); Chang, L.W. *J. Org. Chem.;* **44**: No. 7, 1168-1170(30 Mar 1979).

Results obtained using the boron trifluoride monohydrate and triethylsilane pair are reported. The following compounds did not undergo hydrogenation: naphthalene, phenanthrene, 1-methylnaphthalene, β-naphthalenethiol, phenol, anisole, toluene, and benzene. These compounds were reduced and their reaction products were tabulated: anthracene, naphthacene, 1-hydroxynaphthalene, 2-hydroxynaphthalene, 1-methoxynaphthalene, 2-metholxynaphthalene, 1-naphthalenethiol, α-tetralone, 2-acetonaphthalene, and adamantanone. Measurements were made using gas chromatography, mass spectra, and NMR. The mechanism of this kind of reaction

appears to be protonation followed by hydride abstraction which is rate determining.

43545 Infrared intensities. The methyl halides. Effect of substituents on charge distributions. Wiberg, K.B. (Yale Univ., New Haven, CT). *J. Am. Chem. Soc.;* **101**: No. 7, 1718-1722(28 Mar 1979).

The geometries, force constants, and dipole moment derivatives for methyl fluoride and chloride were calculated using several basis sets. The 4-31G set gave unsatisfactory geometries and dipole moments. The addition of either bond functions or polarization functions led to essentially the same geometrical parameters and dipole moments for both methyl halides which were in agreement with experimental data. Both extended basis sets gave the same dipole moment derivatives which agreed with the experimentally derived values. It is shown that there is a significant difference between the nature of a C-F and a C-Cl bond. Fluorine withdraws charge from the carbon, but does not significantly affect the charge on the hydrogen of the methyl fluoride. Chlorine withdraws charges from both the carbon and the hydrogen in methyl chloride. The dipole moment derivatives are discussed in terms of a rehybridization model.

43546 1,2 shift of phenyl from oxygen to carbon in a free radical. Collins, C.J.; Roark, W.H.; Raaen, V.F.; Benjamin, B.M. (Oak Ridge National Lab., TN). *J. Am. Chem. Soc.;* **101**: No. 7, 1877-1878(28 Mar 1979).

The results of the reaction of tetraline at 400°C with phenetole-α-^{14}C and phenetole-β-^{14}C are reported. Analysis of the products by gas chromotography, mass spectrometry, and product isolation followed by radioactivity assay disclosed that the products were benzene, toluene, ethylbenzene, phenol, methylnaphthalenes, ethylnaphthalenes, and water. The toluene, ethylbenzene, and methyl- and ethylnaphthalenes from phenetole-α-^{14}C all contained ^{14}C, but only the ethylbenzene and alkylnaphthalenes resulting from the reaction of phenetole-β-^{14}C with tetraline were labeled. Tests were carried out to explain these results on the basis of either an inter- or intramolecular shift. Evidence is presented that a 1,2 shift does occur intramolecularly from oxygen to carbon through a free-radical intermediate. (BLM)

43547 Telluroamino acids: synthesis of telluromethionine. Knapp, F.F. Jr. (Oak Ridge National Lab., TN). *J. Org. Chem.;* **44**: No. 6, 1007-1009(16 Mar 1979).

Chemical synthesis of the first known alkyltelluro-substituted α-amino acid, DL-α-amino-γ- (methyltelluro)butyric acid now called telluromethionine is reported. Mass spectral analyses are reported. (BLM)

43548 Interaction of hydrogen and hydrocarbons with transition metals. Neutron diffraction evidence for an activated C—H bond in an electron-dificient tantalum—neopentylidene complex. Schultz, A.J. (Argonne National Lab., IL); Williams, J.M.; Schrock, R.R.; Rupprecht, G.A.; Fellmann, J.D. *J. Am. Chem. Soc.;* **101**: No. 6, 1593-1595(14 Mar 1979).

In order to characterize precisely the molecular structure of an alkylidene complex, the structure of $[Ta(CHCMe_3)(PMe_3)Cl_3]_2$ has been determined by neutron diffraction. The compound crystallizes in the monoclinic space group $P2_1/n$ with refined cell dimensions at 110 K of a = 10.920(6) A, b = 12.827(7) A, c = 10.553(6) A, β = 91.05(2)°, and Z = 2, which imposes a crystallographic center of inversion on the molecule. The initial positions of all independent nonhydrogen atoms were obtained by direct methods using computer codes. The 19 hydrogen atoms were located on a Fourier map with phases calculated from the refined coordinates of the nonhydrogen atoms. Each tantalum atom possesses distorted octahedral geometry and forms and edge sharing dimer with a center of inversion located between the two Ta atoms. The Ta—Ta distance (4.061(2) A) is much greater than in Ta metal (2.86 A) and precludes any direct metal—metal interaction. Important features of the neopentylidene ligand are discussed, including steric crowding and electronic effects on the bond distances and bond angles. 2 figures.

43549 Crystal structure and conformation of the cyclic hexapeptide cyclo-(Gly-L-Pro-D-Ala)$_2$. Kostansek, E.C. (Harvard Univ., Cambridge, MA); Lipscomb, W.N.; Thiessen, W.E. *J. Am. Chem. Soc.;* **101**: No. 4, 834-837(14 Feb 1979).

The crystal structure and conformation of cyclo-(Gly-L-Pro-D-Ala)$_2$, $C_{20}H_{30}N_6O_6$, has been determined by single-crystal x-ray diffraction analysis. The crystals have the symmetry of the orthorhombic space group P2/sub 1/2/sub 1/2/sub 1/ with a = 9.389 (6), b = 10.379 (8), and c = 22.006 (16) A. The structure was solved by direct methods and refined to a final R of 0.055 on 1575 unique reflections. The hexapeptide shows significant deviation from internal twofold symmetry. This asymmetric conformer apparently optimized one single 4 → 1 transannular hydrogen bond at the expense of other possible interactions. Conformation angles are compared with those obtained by CD and NMR techniques, and bond distances are discussed. This hexapeptide contains two type II β turns. All of the peptide bonds are in the transconformation and the C/sub γ/ atom in one of the proline rings is disordered. 5 tables, 3 figures.

ISOTOPE EFFECTS

43550 Nonclassical brexyl cation. A reassessment. Collins, C.J. (Oak Ridge National Lab., TN). *J. Am. Chem. Soc.;* **101**: No. 7, 1878-1880(28 Mar 1979).

Previously published computerized treatment of data on the solvolyses of deuterium- and ^{13}C-labeled β(syn-7-norbornenyl)ethyl-p-bromobenzenesulfonates is criticized as to the conclusions drawn from the data. It is pointed out that differences in certain parameters which are well within experimental error are taken as the sole evidence to support the intervention of nonclassical 2-brexyl cations in product formation. The original conclusions that there is complete degeneracy of the 2-brexyl cation and that there is a considerable counterion effect on product formation are substantiated; however, it is argued that the original data do not support the conclusions which allow a distinction to be made between the two different kinds of intermediates. (BLM)

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 43261, 43262, 43437

43551 Chemically derivatized n-type silicon photoelectrodes. Stabilization to surface corrosion in aqueous electrolyte solutions and mediation of oxidation reactions by surface-attached electroactive ferrocene reagents. Bolts, J.M.; Bocarsly, A.B.; Palazzotto, M.C.; Walton, E.G.; Lewis, N.S.; Wrighton, M.S. (Massachusetts Inst. of Technology, Cambridge). *J. Am. Chem. Soc.;* **101**: No. 6, 1378-1385(14 Mar 1979).

Derivatization of n-type Si photoelectrode surfaces with (1,1'-ferrocenediyl)dichlorosilane results in the persistent attachment of photoelectroactive ferrocene species. Derivatized surfaces have been characterized by cyclic voltammetry in EtOH or H_2O electrolyte solutions. Such surfaces exhibit persistent oxidation and reduction waves, but the oxidation requires illumination as expected for an n-type semiconductor. The oxidation wave is observed at potentials ~ 300 mV more negative than at Pt, reflecting the ability to oxidize ferrocene contrathermodynamically by irradiation. Derivatized n-type Si can be used to sustain the oxidation of solution-dissolved ferrocene under conditions where naked Si is incapable of doing so. Further, derivatized n-type Si has been used in an aqueous electrolyte to oxidize $Fe(CN)_6^{4-}$. Finally, the photooxidation of solution species has been demonstrated to occur via photogeneration of holes in the Si, oxidation of the surface-attached species, and then oxidation of the solution species by the surface-attached oxidant, providing the first direct proof of mediated electron transfer for any derivatized electrode. Derivatized electrodes can be used to sustain the conversion of light to electricity but the efficiencies are low. Based on results for 632.8-nm irradiation, solar energy conversion efficiencies of ~ 1% can be obtained. 7 figures, 1 table.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 42482, 43437

43552 (COO—4940-1) **Laser enhanced chemical reaction studies. Progress report, 1 July 1978—31 March 1979.** (Columbia Univ., New York (USA)). 1978. Contract ER-78-S-02-4940. 16p. Dep. NTIS, PC A02/MF A01.

It was found that COF_2 multiphoton dissociates when pumped by a focused TEA CO_2 laser operating on the P(22) line of the 10.6μ branch with an energy of ~ 500 mJ/pulse. F atoms were produced by the laser and their velocity was essentially thermal (300°K). Parent fluorescence from highly excited COF^2 appeared near 2.5 μ. Serious errors can occur in the measurement of the rate of reaction of atomic fluorine with hydrogen at very low hydrogen pressure.

43553 Photodissociation of formaldehyde: Potential energy surface features. Goddard, J.D.; Schaefer, H.F. III. (Department of Chemistry, University of California, Berkeley California 94720). *J. Chem. Phys.;* **70**: No. 11, 5117-5134(1 Jun 1979).

Features of the S_0 potential energy surface of formaldehyde relevant to its dissociation to molecular products, H_2+CO, to radical formation, H + HCO, and to rearrangement to hydroxycarbene, HCOH, have been studied by means of ab initio calculations. A gradient procedure was used to locate and to characterize both equilibrium and transition state geometries. Basis sets of at least double zeta (DZ) quality were employed throughout and many

calculations involved more flexible basis sets including polarization functions. Force constants, normal modes and vibrational frequencies were calculated at the SCF level for stationary points on the surface. Extensive configuration interaction (CI) calculations were also carried out. For the molecular dissociation the energy barrier including the effects of polarization functions and electron correlation was 4.06 eV (93.6 kcal mole^{-1}, 32 700cm^{-1}). Correcting for changes in zero point vibrational energy gave an approximate activation energy of 3.76 eV (87 kcal mole^{-1}, 30 300cm^{-1}) with an estimated error of +- 0.2 eV (+- 5 kcal mole^{-1}, +- 1700cm^{-1}). The energy required for the rearrangement of formaldehyde to trans-hydroxycarbene was calculated to be 3.85 eV (89 kcal mole^{-1}, 31 000cm^{-1}) at the DZ + polarization + CI level with the inclusion of zero point corrections. The large imaginary frequencies associated with the reactive motion imply sharp and thin barriers through which tunneling is estimated to be of considerable importance. Based on the calculated features of the potential energy surface the mechanism of the photodissociation of formaldehyde is discussed.

43554 Design of a phosphoroscope and the examination of room temperature phosphorescence of nitrogen heterocycles. Ford, C.D.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Anal. Chem.;* **51**: No. 6, 659-663(May 1979).

A phosphoroscope and reflection assembly for a spectrodensitometer is described. They were employed to obtain room temperature phosphorescence (RTP) data from several nitrogen heterocycles adsorbed on dried silica gel and filter paper. The effects of acid and different gases on the RTP of these compounds adsorbed on silica gel and filter paper is discussed. Also, the analytical potential of this new approach is considered. 5 figures, 3 tables.

43555 Reactions in microemulsions. IV. Kinetics of chlorophyll sensitized photoreduction of methyl red and crystal violet by ascorbate. Jones, C.E.; Jones, C.A.; Mackay, R.A. (Drexel Univ., Philadelphia, PA). *J. Phys. Chem.;* **83**: No. 7, 805-810(5 Apr 1979).

The photoreduction of adsorbed dye (methyl red and crystal violet) sensitized by chlorophyll a in an anionic mineral oil in water microemulsion system has been investigated. The 100-A microdroplets occupy 40% of the total volume, and at the pigment concentrations employed ($\leqq$ 10 μM) there is on the average less than one chlorophyll molecule per drop. Using ascorbate as the water-soluble reducing agent, the reaction exhibits a pseudo-first-order dependence on crystal violet, but a pseudo-zero-order dependence on methyl red. The chlorophyll fluorescence is quenched by methyl red, but not by crystal violet. The effect of sensitizer and of ascorbate concentration and light intensity on the quantum yield has also been examined. From the results of these and auxiliary studies, a reaction mechanism is proposed which involves the formation of a chlorophyll-dye triplet exciplex rather than the initial formation of an oxidized or reduced pigment species. Based on this scheme, a number of rate constants have been estimated.

43556 Photochemical pathways of the dimeric, mixed dimer, and monomeric sulfophthalocyanines of cobalt(III) and iron(II). Ferraudi, G. (Univ. of Notre Dame, IN). *Inorg. Chem.;* **18**: No. 4, 1005-1013(Apr 1979).

The photochemical reactivity of the dimeric, mixed dimer, and monomeric sulfophthalocyanines of cobalt (III) and iron (II) was investigated by steady-state and flash irradiations. The dimeric species photodissociated into sulfophthalocyanine radicals which were coordinated to either Co(III) or Fe(II) metal centers. Reactions of such intermediates were investigated by interception with alcohols and O_2. Also, photoredox reactions were detected with monomeric acidocobalt(III) sulfophtahlocyanines. These processes produce the oxidation of the acido ligands (Cl^-, Br^-, N_3^-, I^-) and the reduction of the metal center. The photoredox dissociation was also investigated by using mixed dimers of the cobalt sulfophthalocyanines with $Cr(bpy)_3^{3+}$ and $Ru(bpy)_3^{2+}$. The photogeneration of sulfophthalocyanine radicals was observed as a general reaction which was produced by excitation of either the $Cr(bby)_3^{3+}$ or $Ru(bpy)_3^{2+}$ units in the mixed dimer. The nature of the reactive excited states involved in the various photochemical reactions of the sulfophthalocyanines of Co(II), Co(III), Cu(II), and Fe(II) is discussed.

43557 Competitive processes in retardation by mercaptans of photoreduction by alcohols. Cohen, S.G.; Rose, A.W.; Stone, P.G.; Ehret, A. (Brandeis Univ., Waltham, MA). *J. Am. Chem. Soc.;* **101**: No. 7, 1827-1832(28 Mar 1979).

Reactions of mercaptans and disulfides have been studied in photoreduction of benzophenone by 2-propanol and by benzhydrol, and acetophenone by α-methylbenzyl alcohol, and by the deuterated alcohols. The photoreduction of benzophenone by 2-propanol is retarded by the presence of the mercaptans with greater retardation in the deuterio than in the protio system. This retardation is due largely to hydrogen-transfer reaction. This retardation depends on competition between transfer of hydrogen from mercaptan to the alcohol-derived radical and from this radical to ground-state ketone. The ratio of rate constants for these two reactions of the 2-hydroxy-2-propyl radical is $\sim$ 150. Photoreduction of acetophenone by α-methylbenzyl alcohol is retarded by diphenyl disulfide, and carbon-bound deuterium is introduced into the carbinol. The acetophenone ketyl radical is both reduced by mercaptan and oxidized by thiyl. This retardation is less efficient in the deuterio system and depends on competition between reduction of ketyl by mercaptan and coupling of ketyl radicals. In benzophenone—benzhydrol the rate is halved by 0.01 M 2-mercaptomesitylene, as was the case with 2 propanol, and carbon-bound deuterium is not introduced into the carbinol. This retardation is due predominantly to quenching of triplet by mercaptan and disulfide, in small part to masking, and is the same in the protio and deuterio systems. Photoreduction of benzophenone by 2-mercaptomesitylene, initial quantum yield $\sim$ 0.1, leads to benzpinacol and disulfide. Benzhydrol is not found, confirming that transfer of hydrogen from mercaptan to benzophenone ketyl is too slow to compete with ketyl coupling. Mesityl disulfide is photoreduced by benzhydrol, phi $\sim$ 0.06; such reduction is increased in the presence of benzophenone, presumably by reduction of disulfide and/or thiyl radical by benzophenone ketyl.

43558 Photodisaggregation of chlorophyll a and b dimers. Periasamy, N.; Linschitz, H. (Brandeis Univ., Waltham, MA). *J. Am. Chem. Soc.;* **101**: No. 4, 1056-1057(14 Feb 1979).

At room temperature, chlorophyll a (10^{-4}M) in dry methylcyclohexane containing 0.01M methanol shows only the monomer peak at 661 nm. At -78°C, it is partially converted to dimer, absorbing at 695 nm. Flash photolysis using a 30-ns ruby laser probe selectively excites and bleaches the dimer. The initial difference spectrum shows smaller bleaching in the Soret region and positive transients at 670 nm and in the triplet region 470 to 600 nm. These changes are completely reversible and correspond to cleavage of a dimer to produce triplet and ground-state units. The nascent monomer band at 670 nm is distinctly different from the original monomer (662), indicating a different mode of solvent coordination. The disaggregation demonstrated accompanies a decrease in acidity of magnesium^{2+} in the excited state. Chlorophyll b illustrates similar behavior. Photodisaggregation of the reaction centers has not been fully explained. 3 figures.

43559 Photolysis of nitric acid vapor. Johnston, H.S.; Chang, S.G.; Whitten, G. (Univ. of California, Berkeley). *J. Phys. Chem.;* **78**: No. 1, 1-7(1974).

The primary reaction in the photolysis of nitric acid vapor by ultraviolet radiation is $HNO_3 + h\nu \rightarrow HO + NO_2$ and the primary quantum yield is 1. This article gives experimental evidence in favor of these two conclusions for the wavelengths 200, 255, 290, and 300 nm. The photolysis of nitric acid vapor in laboratory apparatus is subject to several unwanted side reactions, and conditions must be carefully selected to eliminate the effect of such reactions. 7 figures, 2 tables.

RADIATION CHEMISTRY

43560 (ORNL/TM—6699) Conversion of tritium gas to tritiated water. Papagiannakopoulos, P.J.; Easterly, C.E. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

The mechanisms of conversion of tritium gas to tritiated water (HTO) have been examined for several tritium gaseous mixtures. The physical and chemical processes involved in the self-radiolysis of such mixtures have been analyzed and the kinetics involved in the formation of HTO has been presented. It has been determined that the formation of the H and/or OH free radicals, as intermediate species, are of significance in the formation of HTO. Therefore, the problem of reducing the rate of formation of tritiated water in a mixture of gaseous tritium with atmospheric components is one of finding an effective scavenger for the H and/or OH free radicals.

43561 Pulse radiolysis of 4-tert-butyl-1,2-dihydroxybenzene and 4-tert-butyl-1,2-quinone. Richter, H.W. (Carnegie—Mellon Univ., Pittsburgh, PA). *J. Phys. Chem.;* **83**: No. 9, 1123-1129(3 May 1979).

A study has been made in aqueous solution of the radicals produced by hydroxyl radical attack on 4-tert-butyl-1,2-dihydroxybenzene, and by attack of solvated electrons and hydrogen atoms on 4-tert-butyl-1,2-quinone by the technique of pulse radiolysis using optical absorption for the detection of transients. Reaction rates with primary radicals were determined. The spectrum of the semiquinone radical, obtained in acid solution by reaction of OH with the hydroquinone, has absorption maxima at 290 and 390 nm, with extinction coefficients of about 7700 and 1850 $M^{-1}\,cm^{-1}$, respectively. The spectrum of the semiquinone anion, obtained by reduction of the quinone in neutral solution, shows a maximum at 313 nm with a shoulder at 350 nm, having extinction coefficients of about 12200 and 2400 $M^{-1}\,cm^{-1}$, respectively. The pK/sub a/ of the semiquinone radical is 5.2. The absorbance at 310 nm produced by the reaction of

hydroxyl radicals with 4-tert-butyl-1,2-dihydroxybenzene decays by second-order kinetics below pH 7.5. At pH 3, 2k/sub bi/ = 9.0 X 10^8 M^{-1} s^{-1} was obtained for the bimolecular reaction of two semiquinone radicals. As the pH is increased, the rate of second-order decay decreases dramatically, the computed rate constant for bimolecular reaction of two radical anion molecules being 2k/sub bi/ ≦ 4 X 10^6 M^{-1} s^{-1}. The initial radical spectra andabsorbance decay kinetics found in alkaline solutions differ from that in acid and neutral solution, absorbance decay proceeding mainly by first-order kinetics.

43562 Reactivity/rate constant ratio for scavengers of charged particles in nonpolar liquids. Crumb, J.A. (Univ. of Kansas, Lawrence); Baird, J.K. *J. Phys. Chem.;* **83**: No. 9, 1130-1133(3 May 1979).

The reactions of electrons and positive holes with neutral scavenger molecules in nonpolar liquids have been considered. Those cases where the yield G(P) of scavenged electrons or holes per 100 eV of ionizing radiation absorbed follows the empirical formula G(P) = G/sub fi/ + G/sub gi/(α/sub s/c/sub s/)/sup 1/2/[1 + (α/sub s/c/sub s/)/sup 1/2/]$^{-1}$, where c/sub s/ is the scavenger concentration, G/sub fi/ and G/sub gi/ are the free ion yield and gemate ion yield, respectively, and α/sub s/ is an empirical parameter, called the reactivity, which is characteristic of a given solvent—scavenger system have been explicitly analyzed. By combining this formula with the diffusion theory of Magee and Tayler, the following formula: α/sub s//k/sub s/ = (r/sub c/^{3}/D)(G/sub fi//G/sub gi/)^2 has been obtained for the ratio α/sub s//k/sub s/. Here k/sub s/ is the bimolecular rate constant for reaction of the electron or hole with the scavenger, D is the sum of the electron and hole diffusion coefficients, and r/sub c/ = $e^2/\epsilon kT$, where e is the charge of the electron, k is Boltzmann's constant, T is the absolute temperature, and ε is the liquid dielectric constant. For electron scavengers in cyclohexane, n-hexane, and isoctane, at T = 296K, experimental values for α/sub s//k/sub s/ are known and are in satisfactory agreement with the ratio formula. For 14 other liquidsat T = 296K the formula predicts that α/sub s//k/sub s/ lies in the range of 0.04 to 155 ps. The formula also allows the temperature dependence of α/sub s//k/sub s/ to be assessed. For propane at T = 148, 183, and 230K, values of α/sub s//k/sub s/ of 47,0.7, and 0.1 ps, respectively were calculated. Although the ratio formula is specific to the representation of G(P) above, this method of derivation can be applied to any representation of G(P) so long as it is an analytic function of c/sub s//sup 1/2/.

43563 Electron transfer rates and equilibria between substituted phenoxide ions and phenoxyl radicals. Steenken, S.; Neta, P. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 9, 1134-1137(3 May 1979).

The rate constants for electron transfer from a series of substituted isomeric dihydroxy- and diaminobenzenes to different substituted phenoxyl radicals were measured by observing the decay or buildup of one of the radicals invoved. In many cases the electron transfer reactions were reversible and the equilibrium constants could be calculated from the individual rate constants for attainment of equilibrium and from the concentrations of the species involved at equilibrium. From the equilibrium constants the one-electron redox potentials for 15 individual $Q^{-}./Q^{2-}$ pairs were determined, using the value for hydroquinone (23 mV at pH 13.5) as a reference. The potential for catechol (43 mV) is near that of hydroquinone; resorcinol is oxidized much less readily (300 mV), while phenol is even a weaker reductant (>500mV). Methyl, methoxy, and hydroxy substituents decrease the redox potentials while acetyl and carboxyl substituents increase these values. Ascorbate has a potential (15mV) similar to that of hydroquinone, while TMPD (82mV) and p-phenylenediamine (183mV) are less easily oxidized.

43564 Quenching of benzene fluorescence in pulsed proton irradiation. Temperature dependence. West, M.L.; Miller, J.H. (Battelle Pacific Northwest Labs., Richland, WA). *J. Phys. Chem.;* **83**: No. 9, 1205-1207(3 May 1979).

Dilute solutions of benzene in cyclohexane were irradiated with subnanosecond pulses of protons and changes in the time-resolved emission are studied as a function of temperature. Measurements were also made for ultraviolet excitation and the activation energy for quenching by solvent perturbations is compared to other values reported in the literature. An analysis of the radioluminescence data based on dynamic quenching of excited states by proton induced free radicals suggests that most of the temperature dependence is from thermally activated solvent perturbations present under both proton and ultraviolet excitation. The experimental measurements are compared to model predictions and the temperature dependence of model parameters is discussed.

43565 Pulse radiolysis of aqueous hydrazine solutions. The triazene species. Sutherland, J.W. (Brookhaven National Lab., Upton, NY). *J. Phys. Chem.;* **83**: No. 7, 789-795(5 Apr 1979).

Pulse radiolysis of aqueous hydrazine solutions has been studied in the pH range 2 to 13. At times greater than about 1 ms after the pulse, a single transient species is observed (λ/sub max/230nm). This species decayed by first-order kinetics under all conditions studied. A mechanism which accounts satisfactorily for the observed kinetic behaivor is proposed. From the available evidence, this species, identified as triazene (N_3H_3) is amphiprotic and the following acid—base equilibria are rapidly established: $N_3H_4^+ \rightleftharpoons N_3H_3 + H^+$ (pK_1 = 4.95, ΔH_1° = -4.9 kcal mol^{-1}, ΔS_1° = -39.2 eu) $N_3H_3 \rightleftharpoons N_3H_3^- + H^+$ or $N_3H_3 + OH^- = N_3H_4O^-$ (pK_2 = 11.37, ΔH_2° = -4.2 kcal mol^{-1}, ΔS_2° = -67 eu). pK values derived from the dependence of the first-order rate constant on pH, from the dependence of initial absorbance on pH, and from the dependence of the first-order rate constant on temperature at selected values of pH are in satisfactory agreement. The rate constants for decomposition of the acidic and basic forms of triazene are k/sub N3H4+/ = 1.97 X 10^{11} exp(-12600/RT)s^{-1} and k/sub N3H2-/ = 2.14 X 10^{14}. exp(-19200/RT)s^{-1}. For N_3H_3, which is stable relative to the faster reaction rates of its conjugate acid and base forms, k is estimated to be ≦ 0.001 s^{-1} at 24°C. The dependence of the observed first-order rate constant on pH at constant temperature is expressed by the following equation: k/sub obsd/ = [k_3/[1 + (K_1/[H^+])]] + [k_4/[1 + ([H^+]/K_2)]] (k_3 = k/sub N3H4+/ = 133 s^{-1}, k_4 = k/sub N3H2-/ = 2 s^{-1}, pK_1 = 4.9$_5$ and pK_2 = 11.3$_7$). Phosphate is a catalyst for the decomposition of triazene. From studies on the salt effect, it is shown that the conjugate acid of neutral triazene has unit positive charge and its conjugate base has unit negative charge.

43566 Laplace pressure inside micelles. Menger, F.M. (Emory Univ., Atlanta, GA). *J. Phys. Chem.;* **83**: No. 7, 893(5 Apr 1979).

The results of studies of the caging of ice on the germinate recombination of (n-γ)-activated ^{128}I in dilute aqueous mixtures of monoiodotyrosine and diiodotyrosine are reported. The products were identified by high performance liquid chromotography. Three reaction routes leading to ^{128}I-labeled organic products are proposed. The results suggest that the ^{128}I formed remains quite close to its organic radical due to efficient caging ability of the ice lattice.

43567 Kinetics of aquation of the tris(acetylacetonate) complexes of divalent chromium, cobalt, and ruthenium. A pulse radiolytic study. Meisel, D.; Schmidt, K.H.; Meyerstein, D. (Ben-Gurion Univ., Beer-Sheva, Israel). *Inorg. Chem.;* **18**: No. 4, 971-975(Apr 1979).

The kinetics of aquation of $Co(acac)_3^-$ and $Cr(acac)_3^-$ were studied as a function of pH. The reactions leading to the loss of each of the three ligands in $Co(acac)_3^-$ were well separated from each other while in the $Cr(acac)_3^-$ complex the first step was too fast to follow with our experimental technique. The results are in agreement with a mechanism in which the bidentate-bound ligand is in equilibrium with the ligand bound only as a monodentate. These equilibrium constants are estimated. The ligand bound as monodentate is lost by an acid-catalyzed process, with an acid-independent contribution. The aquation reaction of $Ru(acac)_3^-$ is too slow to be measured by the pulse radiolytic technique. $Ru(acac)_3H$ is a relatively strong acid. The results are compared to those obtained for the aquation reaction of $Co(en)_3^{3+}$.

43568 Racemization of isovaline by γ-radiation. Cosmological implications. Bonner, W.A. (Stanford Univ., CA); Blair, N.E.; Lemmon, R.M. *J. Am. Chem. Soc.;* **101**: No. 4, 1049-1050(14 Feb 1979).

Crystalline samples of D- and L-isovaline were irradiated in a 3000-Ci ^{60}Co γ-ray source with radiation doses selected to cause significant but not complete radiolysis. Each sample was quantitatively divided and converted to the appropriate derivatives to be examined by gas chromatography for racemization and degradation. The % racemization accompanying the irradiation is roughly comparable with that noted for the common α-amino acids and for D- and L-leucine. Thus the isovaline in the Murchison meteorite has received a total dose of 5.3 x 10^8 rads, some 60% of the radiation dose which caused 4.8% racemization of crystalline isovaline; so the phenomenon of radioracemization nevertheless, in principle, makes the question of the primordial enantiomorphic composition of amino acids in meteorites an indeterminate one. 1 table.

43569 Radiation process for the production of graft copolymer to be used for ion-exchange membrane. Machi, S.; Sugo, T.; Sugishita, A.; Kanai, S.; Fujiwara, H. (to Japan Atomic Energy Research Inst.; Maruzen Oil Co., Ltd.). US Patent 4,137,137. 30 Jan 1979. Priority date 14 Jul 1976, Japan, 6p.

Preparation of a graft copolymer membrane prepared by co-grafting a mixture of monomers consisting essentially of acyloxystyrene and/or hydroxystyrene. a polyene compound and at least one member selected from the group consisting of acrylic acid, methacrylic acid and esters of these acids onto a hydrocarbon type of fluorine-containing type polymer by means of ionizing radiation is described. The graft copolymer membrane exhibits improved mechanical strength and reduced electrical resistance and provides an excellent ion-exchange membrane.

43570 Effects of trace fillers on the radiation-induced crosslinking of polyethylene. Chappas, W.J.; Silverman, J. (Univ. of Mary

land, College Park). *J. Polym. Sci., Polym. Lett. Ed.;* **17**: No. 1, 5-14(Jan 1979).

Silica-filled samples of low-density polyethylene were subjected to γ and electron irradiation. The insoluble fraction determined by Soxhlet extraction was found to be independent of filler concentrations up to 0.5% by volume. The results show no evidence to support the previously reported work by Gordiyenko et al. of a sharp increase in the gel fraction of irradiated samples with filler concentrations of 0.2%. Substantial changes in the conditions of irradiation and of sample preparation and treatment do not affect gel yields strongly.

43571 Novel cycloaddition of tetrafluoroethylene to the tetrafluoroethylene radical anion at 95°K: direct observation by EPR studies. McNeil, R.I.; Shiotani, M.; Williams, F.; Yim, M.B. (Univ. of Tennessee, Knoxville). *Chem. Phys. Lett.;* **51**: No. 3, 438-441(1 Nov 1977).

The novel cycloaddition reaction $C_2F_4^- + C_2F_4 \rightarrow c\text{-}C_4H_8^-$ has been observed directly by EPR spectroscopy in organic glasses at 80 to 95°K. According to the frontier orbital theory, the concerted reaction is symmetry allowed irrespective of whether the interaction is singly occupied molecular orbital (SOMO)-lowest unoccupied molecular orbital (LUMO) or SOMO-highest occupies molecular orbital (HOMO), the SOMO of $C_2F_4^-$ being the 5b/sub 1u/(σ^*) orbital suggested by EPR studies. The assignment of $C_2F_4^-$ as a σ radical also suggests that a concerted [2 + 2] suprafacial mechanism should be considered for the thermal cycloaddition reaction between two neutral C_2F_4 molecules.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

3572 (RLO—2227/T35-1) **Nuclear chemistry progress report, December 1, 1977—September 1, 1978.** Loveland, W.D. (Oregon State Univ., Corvallis (USA)). 1978. Contract EY-76-S-06-2227-035. 179p. Dep. NTIS, PC A09/MF A01.

The preponderance of the work during this period was on low-energy and relativistic heavy ion research. Five of the papers contained herein have a significant amount of information, and are indexed individually.

HOT-ATOM CHEMISTRY

43573 (COO—1617-58) **High energy halogen atom reactions activated by nuclear transformations. Progress report, February 15, 1978—February 14, 1979.** Rack, E.P. (Nebraska Univ., Lincoln (USA). Dept. of Chemistry). Feb 1979. Contract EY-76-S-02-1617. 70p. Dep. NTIS, PC A04/MF A01.

High energy reactions of halogen atoms or ions, activated by nuclear transformations, were studied in gaseous, high pressure and condensed phase saturated and unsaturated hydrocarbons, halomethanes and other organic systems in order to better understand the mechanisms and dynamics of high energy monovalent species. The experimental and theoretical program consists of six interrelated areas: (1) the reactions of iodine with alkenes and alkynes activated by radiative neutron capture and isomeric transition in low pressure gaseous systems employing additives and rare gas moderators, high pressure and liquid systems; (2) the gas to condensed state transition in halogen high chemistry, involving bromine activated by the (n,γ) and (I.T.) processes in ethane was investigated in more detail; (3) systematics of halogen hot atom reactions. The reactions of ^{80}Br/sup m/, ^{80}Br, ^{82}Br/sup m/ + ^{82}Br, ^{82}Br, ^{128}I, ^{130}I, and ^{130}I/sup m/ + ^{130}I activated by radiative neutron capture or isomeric transition in hydrocarbons and halo-substituted alkanes in low pressure and high pressure gaseous systems employing additives and rare gas moderators; (4) kinetic theory applications of high energy reactions and mathematical development of caging mechanisms were developed; (5) the stereochemistry of ^{38}Cl substitution reactions involving diastereomeric 1,2-dichloro-1,2-difluorethane in liquid mixtures was completed, suggesting that the stereochemical course of the substitution process is controlled by the properties of the solvent molecules; and (6) the applications of high energy chemistry techniques and theory to neutron activation analysis of biological systems was continued, especially involving aluminum and vanadium trace determinations.

43574 Evidence for Walden inversion in high energy chlorine-for-chlorine substitution reactions. Wolf, A.P. (Brookhaven National Lab., Upton, NY); Schueler, P.; Pettijohn, R.P.; To, K.C.; Rack, E.P. *J. Phys. Chem.;* **83**: No. 10, 1237-1241(17 May 1979).

The stereochemistry of high energy chlorine-for-chlorine substitution was studied in gaseous and condensed phase 2(S)-chloropropionyl chloride and 2(R)-chloropropionyl chloride. Greater than 80% inversion of configuration was observed at the chiral center for both high energy ^{38}Cl and /sup 34m/Cl substitution. Net retention is observed in gaseous 2(S)-chloro-4-methylvaleryl chloride where steric hindrance to backside attack is enhanced relative to 2(S)-chloropropionyl chloride. Condensed state data suggest caged radical recombination reactions. 2 tables.

PROPERTIES OF RADIOACTIVE MATERIALS

43575 Chloro-, methyl-, and (tetrahydroborato)tris((hexamethyldisilyl)amido)thorium(IV) and -uranium(IV). Crystal structure of (tetrahydroborato)tris((hexamethyldisilyl)amido)thorium(IV). Turner, H.W.; Andersen, R.A.; Zalkin, A.; Templeton, D.H. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 5, 1221-1224(May 1979).

Reaction of sodium (hexamethyldisilyl)amide with thorium tetrachloride or uranium tetrachloride yields chlorotris-((hexamethyldisilyl)amido)thorium(IV) or -uranium(IV), respectively. The chloroamides of thorium or uranium react with dimethylmagnesium or methyllithium yielding the methyl derivatives $MeTh[N(SiMe_3)_2]_3$ or $MeU[N(SiMe_3)_2]_3$, respectively. The chloro compounds yield $BH_4M[N(SiMe_3)_2]_3$ upon reaction with lithium tetrahydroborate, where M is thorium or uranium. Infrared spectra of the tetrahydroborate derivatives suggest that BH_4 is bonded in a tridentate fashion in both compounds, the metal atoms being six-coordinate. Single-crystal X-ray analysis of the thorium borohydride confirms the infrared result. The white $BH_4Th[N(Si(CH_3))_2]_3$ crystals are rhombohedral with cell dimensions a/sub r/ = 11.137 A and α/sub r/ = 113.61°, the triply primitive hexagonal cell has a/sub h/ = 18.640 (3) A c/sub h/ = 8.604 (1) A, V = 2489 A^3, Z = 3, and D/sub x/ = 1.40 g/cm^3, space group R3m. The structure was refined by full-matrix least squares to a conventional R factor of 0.031 for 1014 data. The Th atom is on a threefold axis 2.32 A from three nitrogen atoms and 2.61 A from the boron atom, a distance which represents a triple bridge bond between Th and B. The three (dimethylsilyl)amide ligands are disordered by a mirror plane parallel to the threefold axis. $CH_3Th[N(Si(CH_3)_3)_2]_3$ is isomorphous with $BH_4Th[N(Si(CH_3)_3)_2]_3$ with cell dimensions a/sub h/ = 18.68 (1) A and c/sub h/ = 8.537 (6) A. The diffraction data yielded integral" = 12.16 +- 0.33 e for the imaginary scattering term for Th with Cu Kα radiation.

43576 Properties and reactions of uranium(IV) tetrahydroborate by ion cyclotron mass spectrometry. Armentrout, P.B.; Beauchamp, J.L. (California Inst. of Technology, Pasadena). *Inorg. Chem.;* **18**: No. 5, 1349-1353(May 1979).

The gas-phase ion chemistry of $U(BH_4)_4$ is studied with the techniques of ion cyclotron resonance spectrometry. An electron impact ionization energy of 9.0 +- 0.5 eV is determined, and appearance energies for several positive fragment ions are reported. These data are analyzed to give ΔH/sub f/[$U(BH_4)_4$] = -7 +- 14 kcal/mol as well as several bond dissociation energies for the parent neutral and its fragment ions. $U(BH_4)_4$ attaches thermal electrons to form the molecular anion. Fragment negative ions are observed with higher energy electrons. The reactions of both positive and negative ions in $U(BH_4)_4$ alone and with other gases are reported. The trapped-electron spectrum is obtained and compared with previous optical spectroscopic studies of $U(BH_4)_4$. Irradiation of major positive ions by a low-power CW CO_2 laser produced no evidence of photochemistry.

43577 Gallium-68 labelling of albumin and albumin microspheres. Wagner, S.J.; Welch, M.J. (Edward Mallinckrodt Inst. of Radiology, St. Louis, MO). Contract EE-77-S-02-4318. *J. Nucl. Med.;* **20**: No. 5, 428-433(May 1979).

Because of the high stability constant of gallium transferrin, the formation of a protein that will be stable in vivo and labeled with gallium-68 (a positron emitter) requires preliminary coupling of a strong chelating group to the protein. In the present study, we have used a reaction developed by Krejcarek and Tucker, in which DTPA is coupled to proteins by the formation of an amide bond. Using human serum albumin (HSA) as a model, we have studied the efficiency of the reaction of HSA with the mixed acid anhydride of the quarternary triethyl ammonium salt of DTPA and butyl formate, as a function of the ratio of albumin to DTPA. After purification of the DTPA-labeled HSA, it is possible to prepare Ga-68-labeled albumin in high yield by chelation of the Ga-68 with the DTPA-labeled protein. In vitro and in vivo stability studies showed that the labeled protein was stable over a period of several hours. The same type of bifunctional chelate has been used to attach Ga-68 to HSA microspheres.

43578 Extraction of pertechnetate with tri(alkyl)methylammonium nitrates. Kinetics and mechanism in the system o-xylene—nitric acid. Dyrkacz, G.R.; Vandegrift, G.F.; Thomsen, M.W.; Horwitz, E.P. (Argonne National Lab., IL). *J. Phys. Chem.;* **83**: No. 6, 670-675(22 Mar 1979).

The extraction kinetics of pertechnetate (TcO_4^-) in the system trioctylmethylammonium nitrate (TOMAN) or tridodecylmethylammonium nitrate (TDMAN) in o-xylene/aqueous nitric acid has been investigated. Procedures for the synthesis and

purification of the TOMAN and TDMAN were developed. The kinetics were performed by stirring the two phases while maintaining a quiescent and constant area interface. Interfacial mass transfer coefficients were measured as a function of concentration of the quaternary ammonium salt, nitric acid, lithium nitrate, and stirring rates. The results of the kinetic experiments show that mass transfer across the interface is rate limiting. Aggregation data were obtained for TOMAN in o-xylene at 25°C. An extraction mechanism is proposed and discussed in terms of aggregation. Both quaternary ammonium salts follow the same kinetic behavior. 9 figures, 1 table.

43579 Phase equilibria in the Cs-U-O system in the temperature range from 873 to 1273 K. Fee, D.C.; Johnson, C.E. (Argonne National Lab., IL (USA)). *J. Inorg. Nucl. Chem.;* **40**: No. 7, 1375-1381(1978).

Portions of the cesium-uranium-oxygen system have been investigated between 873 and 1273 K and a phase diagram has been constructed using these data and the data of other workers in the field. A consistent set of measured and estimated thermodynamic data for cesium uranates has been used to calculate the equilibrium cesium partial pressure and the equilibrium oxygen partial pressure over two and three phase regions in the Cs-U-O system. For a given temperature, the equilibrium cesium partial pressure in a two phase region decreases as the equilibrium oxygen partial pressure increases.

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 43604

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 43528

43580 (COO—2708T017-1) **Department of Energy: some aspects of basic research in the chemical sciences.** (National Academy of Sciences, Washington, DC (USA)). 1979. Contract EY-76-C-02-2708-017. 144p. Dep. NTIS, PC A07/MF A01.

The basic research needs pertinent to DOE's specific mission are identified in the fields of combustion science, coal chemistry, reprocessing of reactor fuel and the disposal of radioactive waste, and analytical chemistry. Aspects of these fields which do not need DOE support are also identified in some cases. In addition recommendations are made on review procedures and funding, use of DOE laboratories by university and other extramural chemists, isotope availability, and critically evaluated data. (JSR)

43581 (KWIS—22/1978) **Soot formation in combustion.** Wagner, H.G. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Oct 1978. 39p. (CONF-780806—4; INKA-CONF—78-195-001). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 17. symposium on combustion; Leeds, UK (20 Aug 1978).

This review covers a selection of experimental results available on soot formation. The goal is to prevent soot emission into the atmosphere, with the provision that this be economically feasible and operationally safe. It is shown by examples that soot formation in gaseous diffusion flames, in turbulent diffusion flames and also in diesel engines is dependent on flame propagation, particle size, residence time, and other parameters. Not included is the growth of soot volume fraction. Therefore modern experimental techniques are to be realized which will contribute much to the understanding of soot formation.

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 42373, 43627, 43644, 43703

43582 (LA-UR—79-1202) **Survey of recent work on explosive-driven magnetic flux compression generators.** Caird, R.S.; Fowler, C.M.; Erickson, D.J.; Freeman, B.L.; Garn, W.B. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 19p. (CONF-781247—2). Dep. NTIS, PC A02/MF A01.

From 2. international conference on energy storage, compression and switching; Venice, Italy (5 Dec 1978).

There are five widely-used classes of explosive-driven flux compression generators. They are the spiral, coaxial, strip, plate and cylindrical implosion systems. The configurations are described and the characteristics of the various types are compared. There are a number of techniques for sharpening or impedance-matching the output pulse of the generators. The use of switching, fuses and transformers are discussed. Some of the areas of application of the generators are outlined briefly. Much of the recent work at Los Alamos has been directed toward the development of the plate generator. This type consists essentially of a transmission line with explosive slabs on the flat surfaces. These plates may be parallel or at an angle with respect to each other. A plane detonation front in the explosive allows a large area of conductor to be driven simultaneously. As a result, the power and current outputs are very high - many megamperes at the terawatt level. This generator is particularly well suited to driving low impedance plasma devices. The results of the plate generator tests are discussed.

43583 (LA-UR—79-1241) **Performance limits for liquid—metal heat pipes containing long adiabatic sections.** Prenger, F.C. Jr.; Kemme, J.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-790803—22). Dep. NTIS, PC A02/MF A01.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Analytical and experimental investigations of the performance limits of liquid—metal heat pipes containing long adiabatic sections were made. An analytical model describing the vapor flow and including the effects of wall friction and compressibility is presented. Performance limits and axial temperature profiles of a sodium-filled, stainless steel heat pipe were measured for comparison with the analytical results. Complete validation of the analytical model requires further experiments. The results show that a transition from laminar to turbulent vapor flow occurs in the adiabatic section with an accompanying decrease in the heat-pipe performance limit. The reduced performance results from an increased wall friction factor for the turbulent flow.

43584 (RFP—2916) **Low torque accurate live centers for grinding.** Burnham, M.W. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 2p. (CONF-790453—1). Dep. NTIS, PC A02/MF A01.

From Society Mfg Engrs international exposition; Detroit, MI, USA (30 Apr 1979).

Live centers for grinding processes must exist in a very harsh environment including griding debris as well as vibration. In addition, the centers must be very accurate and retain the accuracy in the harsh environment. In crush grinding small diameter parts, most live centers were found to have a very short life or to be too stiff to turn. A solution to the short life is presented that preserves good accuracy and requires minimal torque to turn.

43585 (SAND—79-0813) **Development of a 3 MV pulse transformer.** Rohwein, G.J. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

A 3 MV transformer designed for charging high voltage pulse forming transmission lines is described. The transformer is an air core spiral strip design which incorporates ring cage shielding to control edge breakdown in the secondary winding. The physical features of the transformer are described along with its electrical characteristics and the operational results. Air core transformers are an attractive alternative to Marx generators for charging high voltage pulse forming transmission lines (PFL) such as those used with high power electron or ion beam accelerators. Some of the advantages of transformer systems include simplicity, compactness, high reliability, reasonable cost and high energy transfer efficiency. The transformer was designed to demonstrate these features. The primary objective, however, was to establish the feasibility of multimegavolt operation. It was successfully tested to 2.2 MV in an off-resonance, single swing charging mode and to 3 MV in a dual-resonance charging mode. The energy transfer efficiencies for the two modes of operation were 58 and 91%, respectively. A 100 kV, 5 kJ capacitor bank was used to power the transformer for all experiments.

43586 (UCID—16077-79-3) **Hard Structure Munition Project. HSM progress report No. 83, 1—31 March 1979.** Walker, F.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1979. Contract W-7405-ENG-48. 91p. Dep. NTIS, PC A05/MF A01.

Research progress on the Hard Structure Munition HSM Project for March 1979 is reported. During this period a major effort was directed toward completing the environmental testing of the flight version of the HSM. A second major effort was the design, testing and fabrication of the two-fluidic-generator system. (TFD)

43587 (UCID—17755(Pt.3)) **Stress-rupture life of Kevlar/epoxy spherical pressure vessels.** Barlow, R.E.; Toland, R.H.; Freeman, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23

Feb 1979. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

This study of stress rupture has two objectives: to generate baseline data on vessel life under pressure and to apply statistical reliability theory to vessel and strand data in order to predict reliability at given stress levels. The improved life prediction methods useful in the analysis of life data are described. These methods are applied to two sets of data, i.e., the extensive Kevlar/epoxy strand data and the current Kevlar/epoxy spherical pressure vessel data. Of principal importance is the observation that the hazard rates for both data sets are time-dependent at low stress levels; as a result, the exponential lifetime distribution is not valid. Plans are discussed for accelerated life-tests of pre-production units, methods for choosing sample sizes, and in-service replacement policies.

43588 (UCRL—50025-79-1, pp 1-3) **Microcomputer-controller modification increases drill press productivity.** 30 Mar 1979.

In Electronics engineering department. Quarterly report No. 1, 1979.

One of the most common jobs done by LLL machinists is the drilling of circular patterns of holes called bolt-circle patterns. To drill them faster and easier, a numerically controlled drill press was equipped with a microcomputer controller. This natural application for a microcomputer offers several significant advantages such as easy to implement, use, and modify or upgrade. The modified drill press worked so well that the modification of six more machines is planned.

43589 (UCRL—82677) **Magnetic propulsion railguns: their design and capabilities.** Hawke, R.S.; Scudder, J.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1979. Contract W-7405-ENG-48. 32p. (CONF-790540—7). Dep. NTIS, PC A03/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

Recent research was revived interest in electromagnetic railguns. A railgun utilizes the Lorentz force to accelerate an electrically conducting armature, which in turn accelerates a projectile. Our investigation identified the critical parameter that will lead to limits on railgun operation. These limits were incorporated in calculations of the performance of railguns. The calculations indicate that it is possible with present technology to accelerate a projectile to velocities in excess of 20 km/s.

43590 (Y/DA—8211) **Lasers in machine tool controls.** Burleson, R.R. (Oak Ridge Y-12 Plant, TN (USA)). Apr 1979. Contract W-7405-ENG-26. 9p. (CONF-790639—1). Dep. NTIS, PC A02/MF A01.

From 43. Westinghouse annual machine tool forum; Pittsburgh, PA, USA (4 Jun 1979).

A system is described for measuring those parameters which determine the dynamic characteristics of a numerically controlled machine; and, a system to correct for those errors. Both systems utilize a laser interferometer as the measurement transducer. The results of this work contributed to achieving a capability for machining of optical quality surfaces required for the laser fusion program.

43591 (Y/DA—8297) **Computer aided process planning at the Oak Ridge Y-12 plant: a pilot project.** Hewgley, R.E. Jr.; Prewett, H.P. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 19 Apr 1979. Contract W-7405-ENG-48. 12p. (CONF-790534—1). Dep. NTIS, PC A02/MF A01.

From 3. annual TNO users meeting; Arlington, TX, USA (2 May 1979).

In 1976, a formal needs analysis was conducted in one of the Fabrication Division Shops of all activities from the receipt of an order through final machining. The results indicated deficiencies in process planning activities involving special production work. A pilot program was organized to investigate the benefits of emerging CAM technology and application of GT concepts for machining operations at the Y-12 Plant. The objective of the CAPP Project was to provide computer-assisted process planning for special production machining in th shop. The CAPP team was charged with the specific goal of demonstrating computer-aided process planning within a four-year term. The CAPP charter included a plan with intermediate measurable milestones for achieving its mission. In three years, the CAPP project demonstrated benefits to process planning. A capability to retrieve historical records for similar parts, to review accurately the status of all staff assignments, and to generate detailed machining procedures definitely can impact the way in which a machine shop prepared for new orders. The real payoff is in the hardcopy output (N/C programs, studies, sequence plans, and procedures). 4 figures, (RWR)

43592 **Backlash compensator mechanism.** Chrislock, J.L. (to Dept. of Energy). US Patent 4,135,412. 23 Jan 1979. Filed date 14 Dec 1977. 4p.

PAT-APPL-860,654.

The invention discloses a mechanism which compensates for backlash error in a lead screw position indicator by decoupling the indicator shaft from the lead screw when reversing rotation. The position indicator then displays correct information regardless of the direction of rotation of the lead screw.

43593 **Torque balanced vibrationless rotary coupling.** Miller, D.M. (to Dept. of Energy). US Patent Application 929,134. 28 Jul 1978. 9p.

The invention relates to a torque-balanced vibrationless rotary coupling for transmitting rotary motion without unwanted vibration into the spindle of a machine tool. More particularly, a drive member drives a driven member using flexible connecting loops which are connected tangentially and at diametrically opposite connecting points through a free floating ring. Fine machining systems require special coupling techniques to connect a drive motor to a workpiece spindle so that only rotational motion is transmitted. For example, diamond turning machine spindles are presently being driven by long flat belts from remotely mounted motors. However, these flat belts are a source of vibration in that they are not of uniform weight or thickness throughout their length. Also, motor vibration can be transmitted to the spindle by the tension of the belt.

43594 **Linear motor drive system for continuous-path closed-loop position control of an object.** Barkman, W.E. (to Dept. of Energy). US Patent Application 927,442. 24 Jul 1978. 11p.

A precision numerical controlled servo-positioning system is provided for continuous closed-loop position control of a machine slide or platform driven by a linear-induction motor. The system utilizes filtered velocity feedback to provide system stability required to operate with a system gain of 100 inches/minute/0.001 inch of following error. The filtered velocity feedback signal is derived from the position output signals of a laser interferometer utilized to monitor the movement of the slide. Air-bearing slides mounted to a stable support are utilized to minimize friction and small irregularities in the slideway which would tend to introduce positioning errors. A microprocessor is programmed to read command and feedback information and converts this information into the system following error signal. This error signal is summed with the negative filtered velocity feedback signal at the input of a servo amplifier whose output serves as the drive power signal to the linear motor position control coil.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 43126, 43127, 43128, 43129, 43130, 43131, 43259, 43431, 44127, 44128, 44129

43595 (LBL—8510) **Noise and optimization of the dc SQUID.** Tesche, C.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 110p. Dep. NTIS, PC A06/MF A01.

Thesis.

A lumped circuit model for the isolated dc SQUID is developed. A set of coupled non-linear differential equations is derived for the output voltage and circulating current as functions of time. A computer algorithm is developed to compute the time-averaged SQUID I-V characteristics and noise spectral densities.

43596 (UCRL—82046) **LSI-11 based ultrasonic inspection system.** Armstrong, G.H.; Kuramoto, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1979. Contract W-7405-ENG-48. 7p. (CONF-790454—2). Dep. NTIS, PC A02/MF A01.

From DECUS spring mini/midi symposium; New Orleans, LA, USA (17 Apr 1979).

A real-time, microcomputer based, ultrasonic inspection system has been developed in the course of building the Mirror Fusion Test Facility at LLL. The system is designed to evaluate the quality of superconducting cable before it is used to build magnets which will contain fusion reactions. Multichannel data acquisition is accomplished with a high speed A/D converter with DMA. A real-time data analysis program checks data for flaws and reports any damage to a teletype. The software is very interactive and can be used by relatively untrained operators. The system is intended to stand alone in a harsh industrial environment. Programs are written in RT-11/Fortran.

43597 **Low-temperature thermal conductivity of a reticulated glassy carbon.** Gardner, J.W.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *J. Appl. Phys.;* **50**: No. 5, 3012-3014(May 1979).

The thermal conductivity of an interconnected filamentary (reticulated) glassy carbon has been measured between 0.1 and 100 K. The conductivity of the reticulated structure at 4 K is a factor of 1000 smaller than other rigid construction materials typically used

for cryogenic thermal isolation. However, the intrinsic thermal conductivity of the individual filaments of the reticulated structure is identical to that of other glassy carbons, depending only on the temperature of pyrolysis.

43598 Effects of Be alloy additions to the bronze matrix of Nb_3Sn monofilament wires. Luhman, T. (Brookhaven National Laboratory, Upton, New York 11973). *J. Appl. Phys.;* **50**: No. 5, 3766-3767(May 1979).

The superconducting parameters T/sub c/, J/sub c/, and H/sub c/2 have been measured on monofilament Nb_3Sn wires containing 0.20 wt% Be in a Cu+11.2 wt% Sn matrix. J/sub c/ was measured both as a function of applied magnetic fields to 18.0 T and as a function of tensile strain at 4.0 T and 4 K. The Be alloy addition decreases the strain sensitivity of J/sub c/. However, since this improvement results from an increased residual compressive strain in the compound, T/sub c/, J/sub c/, and H/sub c/2 are decreased below corresponding values for a Nb_3Sn wire produced from a binary Cu-Sn matrix. The decrease in J/sub c/ at 14.0 T is nearly 60%.

43599 Winding a multi-pancake magnet from a continuous conductor. Brown, R.L. (to Dept. of Energy). US Patent 4,135,294. 23 Jan 1979. Filed date 24 Mar 1978. 6p.

PAT-APPL-889,665.

A magnet winding method is provided wherein the individual pancakes are fabricated such that adjacent pancakes have oppositely spiraled grooves that begin and end at the same relative locations on the pancakes. Holes through the pancakes are provided at each end of the spirals that permit winding the entire magnet without a single splice.

43600 Cryogenic aspects of the U.S. SCMS superconducting dipole magnet for MHD research. Niemann, R.C.; Wang, S.T.; Gonczy, J.D.; Mataya, K.; Pelczarski, W.J.; Smelser, P.; Vander Arend, P.C.; Stoy, S. (Argonne Natl Lab, Ill). *Adv. Cryog. Eng.;* **23**: 9-16(Aug 1977).

The United States Superconducting Magnet System (U.S. SCMS) is part of the United States-Soviet Union cooperative agreement on magnetohydrodynamics information exchange. As part of the program, the Argonne National Laboratory Superconducting Magnet Group has designed, constructed, and tested a superconducting dipole magnet and its supporting systems. The system consists of the superconducting magnet, a helium refrigerator/liquefier installation, a helium gas recovery system, and the control equipment necessary to operate the magnet and its associated cryogenic equipment.

PROTECTIVE STRUCTURES AND EQUIPMENT

43601 (AD-A—060301) **Study of crisis utilization of small shelter space. Final report oct 77-aug 78.** York, S.B. III; McKnight, J.S. (Research Triangle Inst., Research Triangle Park, NC (USA). Applied Ecology Dept.). Aug 1978. Contract DCPA01-77-C-0232. 110p. NTIS PC A06/MF A01.

The study consisted of an investigation into the options available for utilizing small facilities such as local stores, churches, and schools for nuclear fallout shelters in CRP host areas. Technical consideration was given to the provision of lighting, ventilation, water, and sanitary waste disposal systems for small groups of people. The emphasis of this study was on identifying differences in the characteristics of small facilities versus large facilities and determining the influence of these differences on the provision of services. In describing methods for augmenting and/or providing services, the interrelationships among the different systems in a facility were analyzed. Also, an investigation was made of the relationships of group size and occupant density to the provision of services. Factors relating to the effects of group size and occupant density were examined and presented as an aid to the local planner in developing the shelter plan for a particular host area. All of the analyses were made using existing data already collected. Example problems illustrating the planning required to implement life-support systems are included as an appendix.

43602 (UCID—18054) **Mobile emergency response unit.** Kadi, W.J.; Trolan, R.T.; Becker, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1979. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

The Hotspot quick-response unit was the solution to a requirement to find, identify, and control areas of radioactive contamination at the scene of a nuclear weapons accident. The unit consists of two trucks and two trailers, and is designed to be transported by one U.S. Air Force C-141. One truck (generator truck) carries a 40 kW generator-heater-air conditioner combination, spare tires, and accessories. The other (water truck) carries supplies and a 250-gal water tank. One trailer (counting trailer) contains detecting, counting, and recording equipment. The other (decontaminating trailer) contains a shower, sink, 30-gal hot water tank, and supplies.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 42378

43603 (NUREG/CR—0095) **Nuclear safety guide. TID-7016, Revision 2.** Thomas, J.T. (ed.). (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1 May 1978. Contract W-7405-ENG-48. 142p. (ORNL/NUREG/CSD—6). Dep. NTIS, PC A07/MF A01.

The Nuclear Safety Guide was first issued in 1956 as classified AEC report LA-2063 and was reprinted the next year, unclassified, as TID-7016. Revision 1, published in 1961, extended the scope and refined the guiding information. The present revision of the Guide differs significantly from its predecessor in that the latter was intentionally conservative in its recommendations. Firmly based on experimental evidence of criticality, the original Guide and the first revision were considered to be of most value to organizations whose activities with fissionable materials were not extensive and, secondarily, that it would serve as a point of departure for members of established nuclear safety teams, experienced in the field. The reader will find a significant change in the character of information presented in this version. Nuclear Criticality Safety has matured in the past twelve years. The advance of calculational capability has permitted validated calculations to extend and substitute for experimental data. The broadened data base has enabled better interpolation, extension, and understanding of available information, especially in areas previously addressed by undefined but adequate factors of safety. The content has been thereby enriched in qualitative guidance. The information inherently contains, and the user can recapture, the quantitative guidance characteristic of the formerGuides by employing appropriate safety factors. In fact, it becomes incumbent on the Criticality Safety Specialist to necessarily impose safety factors consistent with the possible normal and abnormal credible contingencies of an operation as revealed by his evaluation. In its present form the Guide easily becomes a suitable module in any compendium or handbook tailored for internal use by organizations. It is hoped the Guide will continue to serve immediate needs and will encourage continuing and more comprehensive efforts toward organizing nuclear criticality safety information.

43604 Remote processing practices and equipment in the transuranium processing plant after ten years of operation. Chattin, F.R.; King, L.J.; Peishel, F.L. (Oak Ridge National Lab., TN). *Proc. Remote Syst. Technol. Div. ANS;* 118-129(1976).

New chemical processing equipment for the production of transuranium elements is more reliable and easier to operate and maintain than the original equipment because of extensive modifications that have been made during ten years of operation. Several new types of devices for transferring the highly radioactive and corrosive fluids involved and for directing and controlling the transfers remotely have been incorporated into the new equipment.

SHIPPING CONTAINERS

43605 (SAND—78-1978) **Description of a materials/coolant laboratory for support of the Breeder Reactor Technology Shipping Program.** Rack, H.J.; Rohde, R.W. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

A description of a facility devoted to evaluating the environmental compatibility and mechanical response of materials suitable for a breeder reactor spent-fuel shipping cask is given. The facility presently consists of a closed-loop servo-controlled hydraulic, horizontal test system coupled to an environmental chamber, generalized mechanical test equipment and high-rate mechanical behavior apparatus. Future plans include the procurement of real-time computer control equipment which will be used to assess the effects of complex load-time histories on spent-fuel shipping cask materials.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 42252

43606 Well tool pack-off with sinker bar release means. Brieger, E.F. US Patent 4,142,583. 6 Mar 1979. Filed date 2 Sep 1977. 10p.

A tool sized for lowering through a tubing string disposed in a well bore by means of wire line and activated upon exiting from the tubing string for setting a pack-off means to close off the cross-section of the tubing string. The wire line is releasable from the tool so that fluid can be removed from the tubing bore thereby producing a pressure differential across the tool. A sinker bar from the surface is dropped through the tubing string and, upon contact with the tool, actuates the tool to release the pressure differential so that the formations below the tubing string may suddenly produce fluid and thereby be cleaned. At the time of release of the pressure differential, the pack-off means is released so that the tool can subsequently drop from the end of the tubing leaving the tubing bore unrestricted.

LASERS

REFER ALSO TO CITATION(S) 42482, 43590

43607 (AD-A—059979) **Optical and discharge studies of novel electronic transition laser species. Interim report.** Leone, S.R. (Colorado Univ., Boulder (USA)). 1 Jun 1978. Contract N00014-77-C-0115,. 33p. NTIS PC A03/MF A01.

A program has been developed to use spectroscopic insight and laboratory experiments to identify potentially important new laser candidates. An innovative series of visible and ultraviolet lasers on high temperature diatomic molecules has been discovered. To date both S_2 and Te_2 have been demonstrated to lase by optical pumping. Because of unique features of the diatomic molecular states, these molecules have potential to make highly efficient laser devices for DoD applications. A series of wavelength tunable photolysis experiments have been carried out on the gas phase molecule HgI_2 In these experiments the quantum yield of excited I(2P1/2) atoms is determined to be unity at the peak of the first long wavelength absorption band. HgI_2 might make an interesting new source of I^* for the 1.315 micrometers I^* laser, since the photolysis products rapidly recombine in a completely reversible way to produce the parent molecule.

43608 (N—79-11398) **Optimum conditions for nonresonant third harmonic generation.** Puell, H.; Vidal, C.R. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (Germany, F.R.). Inst. fuer Extraterrestrische Physik). Dec 1977. 65p. NTIS PC A04/MF A01.

A detailed theoretical analysis of nonresonant third harmonic generation is given which includes the intensity dependent refractive indices of the nonlinear medium as an integral part. According to the third order analytic solution the maximum attainable conversion efficiency is limited only by a nonlinear parameter which is essentially the ratio of the Kerr-constants and the third harmonic coefficient. Only for values of this parameter lower than one intensity (energy) conversion efficiencies in excess of 90% (40%) are possible. The influence of the intensity distribution of the input beam is discussed. Diagrams are given from which the optimum experimental conditions can be deduced in order to get the optimum harmonic output. Limiting processes, such as 5th order effects or self-focusing are analyzed. As an example the optimum conditions for efficient frequency tripling of powerful Nd:glass laser radiation are evaluated.

43609 (NTIS/PS—78/1307) **Hydrogen fluoride and deuterium fluoride lasers. volume 2. 1976-1978 (a bibliography with abstracts). Report for 1976-1978.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Dec 1978. 149p. NTIS PC N01/MF N01.

The chemical reactions, molecular interactions, kinetics, and quantum mechanics in hydrogen fluoride and deuterium fluoride laser development are cited. Studies on excitation, optical equipment, gas mixtures, and window materials for these lasers are included. The spectral output, power, efficiency, applications, and performance of HF and DF lasers are also covered. The updated bibliography contains 142 abstracts, 35 of which are new entries to the previous edition.

43610 (UCRL—81940) **Advanced lasers for fusion applications.** Krupke, W.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1978. Contract W-7405-ENG-48. 25p. (CONF-7808106—1). Dep. NTIS, PC A02/MF A01.

From International conference on lasers 1978; San Diego, CA, USA (20 Aug 1978).

Projections indicate that MJ/MW laser systems, operating with efficiencies in escess of 1 percent, are required to drive laser fusion power reactors. Moreover, a premium in pellet performance is anticipated as the wavelength of the driver laser system is decreased. Short wavelength laser systems based on atomic selenium (λ = 0.49μ), terbium molcular vapors (0.55μ), thulium doped dielectric solids (0.46μ), and on pulse compressions of KrF excimer laser radiaton (0.27μ) have been proposed and studied for this purpose. The technological scalability and efficiency of each of these systems is examined in this paper. All of these systems are projected to meet minimum systems requirements. Amont them, the pulse-compressed KrF system is projected to have the highest potential efficiency (6%) and the widest range of systems design options.

43611 **Method of making a high power laser mirror.** Choyke, W.J.; Hoffman, R.A. (to Westinghouse Electric Corp.). US Patent 4,142,006. 27 Feb 1979. Filed date 27 Feb 1976. 8p.

A method of making a high power laser mirror is described. Essentially the mirror consists of a refractory composition substrate which is polished to an optical finish and overcoated with a high reflectivity metal and a dielectric film disposed to cover the high reflectivity metal. The method includes the hot pressing of the refractory composition, especially silicon carbide, to form a substrate following which an optical finish is polished on one surface thereof. Thereafter, a metal film with a high reflectivity is applied to cover the optical surface and then a dielectric film is deposited over the high reflectivity metal film. Both films are deposited employing process of vacuum evaporation for deposition on the substrate. As thus combined, the mirror exhibits low optical absorptivity, high thermal conductivity, low weight, and low coefficient of thermal expansion. Since the substrate is formed of a hard refractory composition, an excellent optical finish can be polished on the surface thereof.

43612 **Relaxation processes in mixed gas dynamic lasers.** Soloukhin, R.I.; Fomin, N.A. *Dokl. Akad. Nauk BSSR;* 22: No. 12, 1075-1078(Dec 1978). (In Russian).

With the solution of gasdynamic and CO_2—N_2 vibrational relaxation equations, analysis was made of vibrational energy losses associated with relaxation processes in an inverted molecular system with selective thermal excitation and supersonic flow mixing of the pumping and radiative gas components. Optimum operation conditions were determined, and a possibility of regimes with low vibrational losses was found to be feasible at available specific energies up to 200 J/g.

43613 **Post pulse shutter for laser amplifier.** Bradley, L.P. (to Dept. of Energy). US Patent Application 923,753. 11 Jul 1978. 20p.

Apparatus and method are described for quickly closing off the return path for an amplified laser pulse at the output of an amplifier so as to preevent damage to amplifiers and other optical components appearing earlier in the chain by the return of an amplified pulse. The apparatus consists of a fast retropulse or post pulse shutter to suppress target reflection and/or beam return. This is accomplished by either quickly placing a solid across the light transmitting aperture of a component in the chain, such as a spatial filter pinhole, or generating and directing a plasma with sufficiently high density across the aperture, so as to, in effect, close the aperture to the returning amplified energy pulse.

43614 **Entropy, stability and fluctuation in lasing systems.** Bulsara, A.R. Austin, TX; Univ. of Texas (1978). 227p. University Microfilms Order No. 7817622.

Thesis (Ph. D.).

The theory of the generalized entropy derived by Prigogine and co-workers postulates the existence of a quadratic Liapounov function which may be used to prove the asymptotic stability of a dynamic steady state. For an open system, the definition of the entropy must be modified to include an entropy flow. The resulting entropy production is a Liapounov function for a near-equilibrium steady state and in fact, is a minimum in this case. The above considerations are applied to simple laser models, these being examples of open systems far from equilibrium.

43615 **Effect of random aperiodicity on threshold gain of a distributed feedback semiconductor laser.** Stewart, R.W. Ames, IA; Iowa State Univ. (1978). 107p. University Microfilms Order No. 7904021.

Thesis (Ph. D.).

The solution of a linear, one-dimensional, wave equation governing the electromagnetic fields of an optical wave in a periodic structure of the distributed feedback semiconductor laser was obtained with the aid of the truncated Floquet—Bloch approach. The effect of the perturbation in the periodic structure such as an irregularity in the spatial periodicity or in the depth of corrugation in the periodic structure was investigated.

43616 **Optical pulses.** Shapiro, S.L. pp vp of McGraw-Hill yearbook science and technology. New York, NY; McGraw-Hill Book Co., Inc. (1977).

In the past few years picosecond optical pulses and their associated technology have become standard tools for measuring rapid processes in many areas of science and engineering. Similar to spectroscopy, which yields information about the structure of material substances by observing their spectra in the frequency domain, picosecond technology yields information on the dynamical changes in liquids, solids, and gases by observing the evolution of their properties within extremely short time intervals. Because most excitations of materials due to energy absorption relax within picoseconds, the processes involved on a molecular scale can be investigated only with a tool of correspondingly short time resolution. Thus, the reduction of picosecond technology to easily available and widely applied probing techniques has rapidly increased understanding of material transformations. The developments of subpicosecond optical techniques, picosecond electronic devices, and x-ray streak-camera methods are important new advances. Topics discussed include: subpicosecond pulses; picosecond flash photolysis; streak cameras; and short wavelength coherent radiation.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 42913, 42914, 42991, 42994, 43024, 43027, 43036, 43043, 43633

43617 (DP-MS—78-83) **Numerical solution of recirculating flow by a simple finite element recursion relation.** Pepper, D.W.; Cooper, R.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 27p. (CONF-790311—4). Dep. NTIS, PC A03/MF A01.

From 2. international conference on comp. meth. in nonlinear mech.; Austin, TX, USA (26 Mar 1979).

A time-split finite element recursion relation, based on linear basis functions, is used to solve the two-dimensional equations of motion. Recirculating flow in a rectangular cavity and free convective flow in an enclosed container are analyzed. The relation has the advantages of finite element accuracy and finite difference speed and simplicity. Incorporating dissipation parameters in the functionals decreases numerical dispersion and improves phase lag.

43618 (KAPL—4116) **Numerical solution of turbulent flow problems in general geometry.** Wachspress, E.L. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Mar 1979. Contract EY-76-C-12-0052. 24p. (CONF-790620—1). Dep. NTIS, PC A02/MF A01.

From Dundee conference on application of numerical analysis; Dundee, UK (26 Jun 1979).

Turbulent flow of fluid was computed satisfactorily with the Imperial College TEACH program for a wide spectrum of problems. TEACH geometry is restricted to rectangular grids in Cartesian or cylindrical coordinates. The TURF program being developed at KAPL uses the TEACH methodology with foursided isoparametric elements. This broadens modeling capabilities and enhances practical utilization of the TEACH method. It was discovered that a thorough understanding of TEACH numerics was essential for the desired geometry generalization. Crucial aspects of the analysis arise in study of the Navier—Stokes momentum and continuity equations without the complications associated with turbulence modeling common to TEACH and TURF. Among the devices in TEACH are direct computation of primitive variables, interlocking velocity and pressure grids, and derivation of pressure equations from integration over boxes of the continuity equation in which pressures do not appear explicitly. An iteration to consistency of velocities and pressures is superimposed on an iteration on the nonlinear part of the transport term. Linearized velocity and pressure equations are each solved iteratively. Each computation involves an intricate hierarchy of iterations that partially accounts for the limited supportive TEACH convergence analysis. It will be demonstrated that TEACH admits analysis similar to that used for neutron diffusion computation and that several heuristic schemes in TEACH can be motivated by this convergence analysis. Although this analytical basis is far from complete, it has been indispensable in the development of the TURF geometry generalization. 4 references.

43619 (ORNL/MIT—283) **Mass transfer in three-phase fluidized beds.** Gay, F.V.; Holtman, C.B.; Sheppard, N.F. (Oak Ridge National Lab., TN (USA)). 21 Dec 1978. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

Mass transfer experiments were conducted in a 7.62-cm-ID cocurrent three-phase fluidized bed using an aqueous sodium sulfite/air/glass bead system. Absorbed oxygen reacting with the sulfite ion resulted in an oxygen-free liquid phase, so that mass transfer was independent of liquid axial dispersion. A discontinuous-phase sampling system was developed to enable gas-phase analysis along the bed. These concentration data were used to calculate mass transfer coefficients within the two- and three-phase regions of the column. Bead diameters of 3.2, 4.6, and 6.2 mm were used at superficial gas velocities of 4.3 to 12.9 cm/s and liquid velocities of 1.28 to 11.2 cm/s. The three-phase mass-transfer coefficient (K/sub L/a) was found to decrease with increasing gas velocity at very high and very low gas velocities; a direct proportionality was found for intermediate velocities. K/sub L/a) first decreased, then increased with increasing liquid velocity. Increasing the bead diameter caused an increase in the mass transfer coefficient at low gas velocities and a decrease at higher gas velocities. The existence of three regions (bubble coalescence, bubble disintegration, and slugging) are postulated to account for this behavior. Dispersion coefficients, E/sub L/, were calculated using experimentally determined K/sub L/a's and liquid-phase concentration data from earlier studies. The values obtained are nearly zero, suggesting the liquid phase is also in plug flow. Further mass transfer experiments over a wider range of U/sub L//U/sub MF/ and U/sub G/ are recommended.

43620 **Low Peclet number heat transfer for power law non-Newtonian fluid with heat generation.** Dang, V.D. (Brookhaven National Lab., Upton, NY). *J. Appl. Polym. Sci.;* **23**: No. 10, 3077-3103(15 May 1979).

Heat transfer for power law non-Newtonian fluid with heat generation and axial conduction is analyzed. Radial and axial temperature distribution and the Nusselt number inside a tube are obtained in terms of nonorthogonal series expansion. Eigenvalues and eigenfunctions are given for different values of various parameters. The effects of Peclet number, power law model index, viscous dissipation, and heat generation on the temperature distribution and Nusselt number are discussed. Comparison of the present results for extreme cases with those obtained by previous workers shows good agreement. 8 figures, 17 tables.

43621 **Experimental study of thermally-induced flow oscillations in supercritical helium.** Daney, D.E.; Ludtke, P.R.; Jones, M.C. (Thermophysical Properties Division National Engineering Laboratory, National Bureau of Standards Boulder, Colorado 80303). *J. Heat Transfer;* **101**: No. 1, 9-14(Feb 1979).

The density wave stability boundary has been experimentally determined for supercritical helium flowing in a long ($L < 185$ m), heated channel of high aspect ratio ($L/d < 4.6\ (10)^4$). A pressure drop ratio and the fluid expansion ratio correlate the oscillation inception point data. The growth of enthalpy (temperature) perturbations in a heated channel has been experimentally verified. During the density wave oscillation, the channel exit temperature and inlet mass flow were observed to be in phase, and the oscillation period was close to twice the fluid transit time. All three observations agree with a simple incompressible flow model. Oscillation amplitudes as great as 11 K and 100 percent of inlet flow were observed.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 43696, 43867

43622 (CONF-760903—P5, pp 4p, 3L9) **Neutron radiometric testing of laminated products with metal screens of variable thickness.** Gorbunov, V.I.; Pekarskii, G.Sh. (Polytechnical Inst., Tomsk, USSR). 1976.

From 8. world conference on nondestructive testing; Cannes, France (6 Sep 1976).

Testing of light material parameters (thickness, presence of defects and others) is considered, when this light material is shielded with metal screens or shells of fluctuating thickness.

43623 (EPRI-NP—758(Vol.2)) **Multifrequency eddy current system for steam generator tubing inspection. Volume 2: analytical studies. Interim report.** Libby, H.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 169p. Dep. NTIS, PC A08/MF A01.

A multifrequency eddy current testing system has been developed to test nuclear steam generator tubes and has been evaluated on a steam generator mockup. Results to date show that use of more than one inspection frequency facilitates electronic assessment of flaw depth, thereby reducing reliance on visual interpretation of signal information by operators. This interim report on Research Project 403 consists of two volumes. Volume I, Progress Summary, provides details on the system design and an evaluation of the system's performance on a steam generator mockup. The system consists of a four frequency signal generator,, which excites the inspection coil, followed by a Walsh function instrument which extracts information from any two of the four frequencies present in the composite test signal. The extracted information is processed to discriminate against unwanted signals, such as those from probe wobble, and is then transmitted to the defect decision circuitry for additional processing. Results of the mockup tests show that the system has a higher probability of flaw detection in many cases than does a conventional single frequency test. Volume II, Analytical Studies, provides tutorial sections on algebraic solutions of simultaneous equations and on representation and analysis of signals using orthogonal functions. These sections are followed by examples illustrating the design of the multifrequency inspection system. Also presented is an analytical study of several candidate means for implementing electronic assessment of flaw depth.

43624 (HEDL-SA—1705) **Experimental electro-thermal method for nondestructively testing welds in stainless steel pipes.** Green, D.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 19 Jan 1979. Contract EY-76-C-14-2170. 29p. (CONF-790366—1). Dep. NTIS, PC A03/MF A01.

From National American Society for Nondestructive Testing spring conference; San Diego, CA, USA (2 Mar 1979).

Welds in austenitic stainless steel pipes are notoriously difficult to nondestructively examine using conventional ultrasonic and eddy current methods. Survace irregularities and microscopic variations in magnetic permeability cause false eddy current signal variations. Ultrasonic methods have been developed which use computer processing of the data to overcome some of the problems.

Electro-thermal nondestructive testing shows promise for detecting flaws that are difficult to detect using other NDT methods. Results of a project completed to develop and demonstrate the potential of an electro-thermal method for nondestructively testing stainless steel pipe welds are presented. Electro-thermal NDT uses a brief pulse of electrical current injected into the pipe. Defects at any depth within the weld cause small differences in surface electrical current distribution. These cause short-lived transient temperature differences on the pipe's surface that are mapped using an infrared scanning camera. Localized microstructural differences and normal surface roughness in the welds have little effect on the surface temperatures.

SAFETY ENGINEERING

REFER ALSO TO CITATION(S) 43265

43625 (LA—7597-MS) **Design of safe electrical equipment for research.** Rand, J.L.; Leep, R.W.; Bradley, W.A. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 59p. Dep. NTIS, PC A04/MF A01.

Design information needed by research personnel engaged in the construction and operation of experimental apparatus is presented with emphasis on electrical safety. Figures, charts, and tables are used to present reference data. General information on the construction and use of Marx generators and high-voltage capacitor energy storage banks is presented with emphasis on electrical safety.

43626 (NVO—410-02(Rev.5)) **Cross-index to DOE-prescribed industrial safety codes & standards.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Jan 1979. Contract EY-76-C-08-0410. 613p. Dep. NTIS, PC A99/MF A01.

A cross-index volume of the 1979 compilation of detailed information from more than two hundred and seventy DOE prescribed industrial safety codes and standards is presented. Condensed data from individual code portions are listed according to reference code, section, paragraph, and page. Each code is given a two-digit reference code number or letter in the Contents section (pages C to O) of this volume. This reference code provides ready identification of any code listed in the cross-index. The computerized information listings are on the left-hand portion of cross-index page; in order to the right of the listing are the reference code letters or numbers, the section, paragraph, and page of the referenced code containing expanded information on the individual listing. Simplified How to Use directions are listed.

43627 (PUB—3001) **Rules and procedures for the design and operation of hazardous research equipment.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 130p. Dep. NTIS, PC A07/MF A01.

The manual has been prepared for use by research personnel involved in experiments at the Lawrence Berkeley Laboratory. It contains rules and procedures for the design, test, installation, and operation of hazardous research equipment. Sect. I contains such information as responsibility of experimenters for safety, descriptions of the various Laboratory safety organizations, and enumeration of various services available to experimenters at the Laboratory. Sect. II describes specific rules for the setup and operation of experimental equipment at the Laboratory. Sect. III gives detailed design criteria and procedures for equipment frequently encountered in the high energy physics laboratory.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 43700, 44065

43628 (BDX—613-2138(Rev.)) **LSI process development. Final report.** Clements, D.W. (Bendix Corp., Kansas City, MO (USA)). Jun 1979. Contract EY-76-C-04-0613. 25p. Dep. NTIS, PC A02/MF A01.

Advancements in microelectronic technology have led to the development of metal-oxide semiconductor large-scale integrated circuit (LSI) components. Sandia Laboratories, Albuquerque (SLA) is now incorporating these advanced components in designs for products to be manufactured at Bendix Kansas City. A project was undertaken to develop a Bendix component engineering support capability for LSIs, and to assure that procurability considerations are included in the LSI design effort. The following three related topics are covered: (1) a general overview of the LSI design process as performed at SLA; (2) a review of the SA2475 LSI manufacturing effort at the Semiconductor Development Laboratory of SLA; and (3) considerations for establishing a commercial company as a vendor for LSI components.

43629 (SAND—78-1481) **CHESS relay life tester.** Gustke, F.R. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 83p. Dep. NTIS, PC A05/MF A01.

A CHESS Relay Life Tester that has the unique capability of capturing the operation state of a relay during failure is described. CHESS is an acronym for "Catch and Hold the Error Snap Shot." The tester can interface with up to 24 sets of contacts. With loads up to 10 amperes, it can test for open or weld contact conditions. A complete description of the CHESS Relay Life Tester is given. The operating procedures for system use are also outlined. A channel overlay system provides an independent test system for suspicious failures. The addition of a computer system to the CHESS unit is introduced but will be detailed in a subsequent report. The computer system will allow failure logging, insure automatic functional testing in the event of failure, and restart the system during nonoperational hours.

43630 (SAND—79-0049C) **Placement algorithms for arbitrarily shaped blocks.** Preas, B.T.; vanCleemput, W.M. (Stanford Univ., CA (USA)). 1979. Contract EY-76-C-04-0789. 32p. (CONF-790626—1). Dep. NTIS, PC A03/MF A01.

From 16. design automation conference; San Diego, CA, USA (25 Jun 1979).

New placement algorithms were developed which are suitable for the layout of very large integrated circuits. Hierarchical decomposition is used to reduce the circuit function to a size that can be comprehended by the designer and is computationally feasible to lay out. At each hierarchy level the problem is reduced to the placement of interconnected rectangular blocks of arbitrary size and shape such that the area of a rectangle enclosing the blocks and their interconnection is minimum. Constructive initial placement and iterative improvement algorithms are presented.

43631 (UCRL—50025-79-1) **Electronics engineering department. Quarterly report No. 1, 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1979. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC A03/MF A01.

Separate abstracts have been prepared for individual sections.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 43348

43632 (DOE/TIC—10115) **Dutchess County Pyrolysis Project. Draft feasibility report of three sites.** (Velzy (Charles R.) Associates, Inc., Mineola, NY (USA)). Feb 1979. Contract EM-78-G-01-5143. 45p. Dep. NTIS, PC A03/MF A01.

Four sites near the Hudson River in Dutchess County, NY were evaluated for locating a solid waste Purox pyrolysis plant. Based on a comparison of geologic conditions, topography, construction costs, available utilities, and land use compatibility, the Arlington site is recommended. (LCL)

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 42829, 42847, 43258

43633 (FE—1787-11) **Modeling of a fluidized bed combustor with immersed tubes. Quarterly report, March—August 1978.** Saxena, S.C.; Grewal, N.S. (Illinois Univ., Chicago (USA). Dept. of Energy Engineering). Dec 1978. Contract EX-76-C-01-1787. 22p. Dep. NTIS, PC A02/MF A01.

The total heat transfer coefficient is measured between electrically heated bundles of tubes (12.7 and 28.6 mm diameter) and a square fluidized bed (0.305 x 0.305m) of silica sand and alumina. The staggered tube bundle has its tubes located at the vertices of equilateral triangles. The effect of particle size, mass fluidizing velocity (up to 0.66 kg/m^2s), tube pitch (1.75 to 9.00 times the tube diameter), and bed height on heat transfer rate is investigated.

43634 (FE—2452-15) **Hot corrosion/erosion testing of materials for application to advanced power conversion systems using coal-derived fuels. Task II: fluidized bed combustion. Monthly technical report, September 1—30, 1977.** Nutkis, M.S.; Bertrand, R.; Loughnane, M.D. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). 6 Oct 1977. Contract EX-76-C-01-2452. 10p. Dep. NTIS, PC A02/MF A01.

Three tests of the Miniplant granular bed filter were accomplished. Modifications to the granular bed filter involved the addition of methane injection, outlet piping manifolds, and insulation. Granular bed filter exit temperatures of 1550°F were attained for short intervals.

43635 Process and apparatus for the partial combustion of coal powder. van Herwijnen, T.; Paul, C.J. (to Shell Internationale Research). US Patent 4,146,370. 27 Mar 1979. Priority date 4 Dec 1975, Netherlands, 10p.

A novel partial combustion process and apparatus are disclosed wherein coal powder is passed from a fluidization vessel operated at high pressure to a gasification reactor operated at a substantially constant small pressure increment below the pressure of the fluidization vessel. Coal powder solids are introduced into the fluidization vessel through coal powder supply means while the fluidization gas is introduced into the fluidization vessel to fluidize the coal powder solids in the fluidization vessel. The fluidized powder is discharged through novel passage means in a direction perpendicular to the direction of flow of the fluidization gas flowing into the vessel, so that the fluidized coal powder is concentrated during flow and is uniformly dispersed, whereby the transfer rate of the coal powder is substantially increased, thereby making it possible to use smaller sizes of equipment for the same volumes handled.

43636 Flare burner. Straitz, J.F. III. (to Combustion Unlimited Inc.). US Patent 4,137,036. 30 Jan 1979. Filed date 28 Mar 1977. 4p.

The flame burner is designed to contain a central combustion chamber and a cylindrical enclosure, both of which are open at the top for discharge of combustion products. The structure is elevated and open at the bottom for entrance of air for combustion. A plurality of combustion stages are provided, one in the central chamber and another in the cylindrical enclosure. An acoustical and wind shielding fence is provided outside the bottom of the cylindrical enclosure. The principal object of the design of the invention is to provide a device which is effective in the disposal of waste combustible gases, which does not require excessive area for installation, and which does not adversely effect the environment. 2 figures, 3 drawing.

43637 Alloy performance in Rivesville AFBC boiler corrosion test. Godfrey, T.G.; DeVan, J.H.; Crouse, R.S.; Allen, M.D. (Oak Ridge National Lab., TN). *Mater. Compon. Newsl.;* No. 19, 1-2 (1 Dec 1978).

The three heat exchanger steels from cells A and B show some evidence of corrosive attack although the amount does not appear excessive for the intended test program. Other ORNL experiences with various steels exposed in the Fluidyne AFBC at higher temperatures (around 1600°F) have shown that attack tends to be relatively rapid during the first 500 hours, but the rate tends to decrease rapidly as protective oxide films are developed. The surfaces of all the tube samples examined showed a discontinuous, thin sulfate deposit over the oxide scale, and no indications of sulfide attack were found. The latter would not be anticipated at the tube operating temperatures for the nominal excess air levels at the Rivesville plant. The Inconel 601 ladders, however, demonstrated a pronounced tendency for subsurface sulfidation attack although the attack appears acceptable for the proposed duty cycle. When the Rivesville boiler was designed in 1973, Inconel 601 was selected for its strength and corrosion resistance. It is now generally accepted that high nickel alloys do not perform as well in AFBC's as do the iron-base austenitic alloys. Observations on the Inconel 601 specimens at Foster—Wheeler indicate that cold worked surfaces appeared somewhat more resistant to sulfidation than mill-finished surfaces, but the resistance decreases if recrystallization occurs in service.

43638 Heat exchange tube for fluidized bed reactor. Thompson, G.J. (to UOP Inc.). US Patent 4,124,068. 7 Nov 1978. Filed date 16 May 1977. 2p.

Liquid containing heat transfer tube for use in a fluidized bed reactor is disclosed which is protected against erosive effects of the fluidized medium by having radially outwardly extending fins on its outer surface and by having the entire outer surface area between the fins covered by a layer of an abrasion resistant refractory which is supported by a metallic substrate such as expanded metal. 6 claims, 2 figures

43639 Experiences in regenerating sulfated limestone from fluidized-bed combustors. (Argonne Natl Lab, Ill). pp 394-400 of Fluidization. Vogel, G.J.; Montagna, J.; Swift, W.; Jonke, A.A. New York, NY; Cambridge Univ. Press (1978).

From Conference on fluidization; Cambridge, UK (1 Apr 1978).

The experiences at Argonne National Laboratory in developing a process for regenerating the partially sulfated limestone product from a fludized-bed combustion process are described. Studies of candidate processes and the further development of the reductive-decomposition process wherein $CaSO_4$ is converted to CaO in a fluidized bed at 1100°C are discussed. Reductive decomposition reaction rates are rapid--less than 10 miuntes is required for effective regeneration. A gas containing SO_2 at concentrations near 10% is produced. Stones were cycled batchwise between the combustor and regenerator to demonstrate that reactivity of the stone can be sufficiently maintained and that attrition rate of particles in the fluid bed is low. Regeneration can significantly reduce the quantity of fresh stone required in the combustion step.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 43293, 43865

MARINE ENGINEERING

43640 Acoustical underwater communication system for command control and data. Patten, H.T.; Woodcock, F.B. (to Bunker Ramo Corp.). US Patent 4,147,222. 3 Apr 1979. Filed date 6 Sep 1977. 12p.

An acoustic communication system is disclosed as a secondary means for command control of underwater operations from a surface unit. The system includes a diving acoustic command control unit for use in the event of prime propagation path occlusion. Self-check verification as well as data read-out upon interrogation is provided from the surface unit to an underwater receiver-transpondr. The latter will also respond to acoustic command signals from the diving unit. An early warning blowout detector employs sensors at the wellhead to detect seismic waves, mud pressure wave fronts and mud flow rates resulting from an emerging blowout and in response thereto, transmits an alert signal.

43641 Pivotal connecting device for pivotally connecting an off-shore articulated column structure to a sea bottom. Tuson, S. (to Enterprise d'Equipments Mecaniques). US Patent 4,142,820. 6 Mar 1979. Priority date 13 Jan 1977, France, 16p.

The invention described is a universal Cardan joint coupling device for pivotally connecting an off-shore oil-field working articulated column to a base member resting or anchored on the sea bed. At least one of the pivot axes of the joint is connected to two supports rigidly connected to the base member. Two lock-bolts are aligned on either side of the joint, and are displaceable along said axis. They are adapted to cooperate with bolt-clasps or keepers provided in said supports. 26 figures, 10 drawing.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 42852, 43728

43642 Electrostatic dust precipitators. Keiichi, H. US Patent 4,126,434. 21 Nov 1978. Priority date 13 Sep 1975, Japan, 6p.

In an electrostatic dust precipitator of the type including a dust collection electrode structure and a discharge electrode structure which are impressed with dc voltages of the opposite polarities, the discharge electrode structure is constituted by a plurality of rod shaped parallel electrodes having a substantial surface area and discharge members.

POWER CYCLES

BRAYTON

REFER ALSO TO CITATION(S) 42843

RANKINE

REFER ALSO TO CITATION(S) 43329, 43333

STIRLING

REFER ALSO TO CITATION(S) 42484

43643 (DOE/NASA/1040—78/30) **Initial comparison of single cylinder Stirling engine computer model predictions with test results.** Tew, R.C. Jr.; Thieme, L.G.; Miao, D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EC-77-A-31-1040. 38p. (NASA-TM—79044; CONF-790216—4). Dep. NTIS, PC A03/MF A01.

From 1979 SAE Congress and Exposition Engine Modeling Session; Detroit, MI, USA (26 Feb 1979).

A Stirling engine digital computer model developed at NASA Lewis Research Center has been configured to predict the performance of the GPU-3 single-cylinder rhombic drive engine. Revisions to the basic equations and assumptions previously reported on are discussed. Initial comparisons of the model predictions with

the early results of the Lewis Research Center GPU-3 tests are made.

43644 Liquid piston heat-actuated heat pump and methods of operating same. Gerstmann, J.; Friedman, Y. US Patent 4,148,195. 10 Apr 1979. Filed date 12 Dec 1977. 10p.

A heat-actuated heat pump is disclosed having liquid pistons which displace the working gas and transmit power between expanding gas and compressing gas. Power output from expanding sections is transmitted to compressing sections without intervening mechanical shafts or levers, and the phasing of the various pistons is self-regulated, thereby eliminating the need for phase control mechanisms, such as crankshafts. The engine and heat pump operate in a thermally regenerated cycle without valves, closely approximating a Stirling cycle.

OTHER

REFER ALSO TO CITATION(S) 42842

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 43984

43645 Linear induction accelerators made from pulse-line cavities with external pulse injection. Smith, I. (Ian Smith Incorporated, Alameda, California 94501). *Rev. Sci. Instrum.;* **50**: No. 6, 714-718(Jun 1979).

Two types of linear induction accelerator have been reported previously. In one, unidirectional voltage pulses are generated outside the accelerator and injected into the accelerator cavity modules, which contain ferromagnetic material to reduce energy losses in the form of currents induced, in parallel with the beam, in the cavity structure. In the other type, the accelerator cavity modules are themselves pulse-forming lines with energy storage and switches; parallel current losses are made zero by the use of circuits that generate bidirectional acceleration waveforms with a zero voltage-time integral. In a third type of design described here, the cavities are externally driven, and 100% efficient coupling of energy to the beam is obtained by designing the external pulse generators to produce bidirectional voltage waveforms with zero voltage-time integral. A design for such a pulse generator is described that is itself one hundred percent efficient and which is well suited to existing pulse power techniques. Two accelerator cavity designs are described that can couple the pulse from such a generator to the beam; one of these designs provides voltage doubling. Comparison is made between the accelerating gradients that can be obtained with this and the preceding types of induction accelerator.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 43681, 43685, 43686

43646 (CONF-790327—135) **Transport experiments with neutralized and space charge dominated deneutralized 2 mA 80 keV Xe^{+1} beams.** Mazarakis, M.G.; Burke, R.J.; Colton, E.P.; Fenster, S.; Moenich, J.S.; Nikfarjam, D.K.; Price, D.W.; Sesol, N.Q.; Watson, J.M. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Portions of document are illegible.

The Argonne National Laboratory Ion Beam Fusion group is presently studying the transport and charge neutralization of beams of heavy ions using a small PDPE (Penning Discharge Pierce Extraction) ion source. This source is a scaled down version of the high current high brightness source of the 1.5 MeV Heavy Ion Preaccelerator. Both sources were developed by Hughes Research Laboratories. This report gives results obtained with a low vacuum system (up to 5×10^{-7} torr static vacuum) and an 80 keV dc Xe^{+1} beam. The emphasis of these measurements was on neutralization times and space charge blow up of the beam.

43647 (LBL—7574, pp 78-81) **Tevatron used as p-anti p collider.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

The use of electron cooling to obtain anti proton—proton colliding beams in the Fermilab Tevatron is described. The expected performance is discussed. (GHT)

43648 (LBL—7574, pp 102-105) **Colliding beams: limitations/instabilities.** Ruggiero, A.G.; Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

For the high-intensity proton bunches in the Fermilab scheme, it is concluded that: (1) If the longitudinal emittance is larger than 0.35 eV-sec per bunch, there will be no trouble in adiabatic debunching in the Main Ring at 100 GeV. (2) The head—tail instability can be controlled in the usual manner by adjusting the chromaticity and using the feedback damper. (3) Harmful spurious resonances in the rf cavities must be shorted to impedances below 30 kΩ. As long as the beam bunches are longer than approximately 2 m, there will be no trouble with either longitudinal or transverse bunch-to-bunch instabilities. Eventually a Landau cavity can be used to shorten the bunches. (4) A bunch spreader is required for the Energy Doubler to adjust the final bunch area to the threshold of instability. (GHT)

43649 (LBL—7574, pp 157-160) **Nonlinear electron—proton interactions during electron cooling.** Ruggiero, A.G. (Fermi National Accelerator Lab., Batavia, IL). 1978.

From p-p workshop; Berkeley, CA, USA (27 Mar 1978).

In electron cooling, the area of the electron beam can be regarded as a solid, continuous charge distribution with which one associates a rigid, continuous field. The effect of this field on the stability of the motion of protons or anti protons in the accelerated beam is considered. (GHT)

43650 (TRI-PP—79-6) **Variable energy polarized proton beam at TRIUMF.** Beveridge, J.L.; Craddock, M.K.; Dutto, G.; Mackenzie, G.H.; Oram, C.; Root, L.W.; roy, G.; Schmor, P.W. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility; Alberta Univ., Edmonton (Canada)). Mar 1979. 3p. (CONF-790327—141). TIC.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A polarized H^- current of 1 μA has been achieved within a normalized emittance of 0.3π mm-mrad from a Lamb-shift type source. 80% of the beam is routinely transported at 300 keV along the 45 m long electrostatic injection line to the cyclotron, where 200 nA can be accelerated to 500 MeV and extracted. A Wien filter, located near the entrance of the injection line, is used to compensate for the precession resulting from the cyclotron's fringe field and to align the spin vertically. Depolarization along the line has been calculated to be less than a few per cent. The polarization, enhanced with a diabatic zero crossing in the source, is approximately 80%; however, a slight loss in polarization has been measured in the cyclotron between 200 and 500 MeV.

43651 (TRI-PP—79-7) **Improved beam quality at TRIUMF.** Blackmore, E.W.; Craddock, M.K.; Dutto, G.; Hutcheon, D.A.; Kost, C.J.; Liljestrand, R.; Mackenzie, G.H.; Miller, C.A.; Rogers, J.G.; Schmor, P.W. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility; Alberta Univ., Edmonton (Canada)). Mar 1979. 3p. (CONF-790327—143). TIC.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Improved stability, together with the use of beam-defining apertures, have enabled us to obtain separated turns at 200 MeV. This implies an extracted energy spread of 0.25 FWHM and a time width of 0.3 ns FWHM; 0.6 MeV and 0.6 ns, which includes instrumental resolution, have been measured. Mechanical stiffening of the rf resonators has recently reduced the dee voltage fluctuations to +- 0.015% while the magnetic field fluctuations are $+- 2 \times 10^{-6}$. The machine set-up procedure for separated turns will be described. The compensation of the residual magnetic first harmonic has also been improved and should eventually permit lower loss in high-current operation.

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 43585

43652 (DOE/ER—01388-345, pp 8-12) **Improved design for a spiral-resonator postaccelerator for the UW three stage FN tandem accelerator.** Chamberlin, D.D.; Cramer, J.G. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

The energy performance of the new postaccelerator design at 20% duty factor was calculated for beam injected from three-stage and two-stage FN tandem. 3 figures. (RWR)

ION SOURCES

43653 (LBL—8810) **Wideroe-based heavy ion preaccelerator for the SuperHILAC.** Staples, J.W.; Lancaster, H.D.; Yourd, R.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 5p. (CONF-790327—109). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A new high-mass, high intensity injector for the SuperHILAC has been approved and is under construction at LBL. A high power intermediate charge state ion source and accompanying low-velocity linac will provide beams for subsequent acceleration by the SuperHILAC. Both axially and radially extracted ion sources will be accommodated and charge state analyzed in the 750 kV, 100 kHz Cockcroft-Walton terminal. The LEBT will provide isotopic analysis to 1 part in 300. A 5m long, 23.4 MHz Wideroe linac, operating in the π -3 π mode based on the GSI design accelerates typically a U^{+8} ion to 113 keV/a where it is stripped to U^{+11} by a perfluoropolyether vapor stripper and further accelerated by the SuperHILAC. The space charge limit of the system is several electrical mA which will be approached in the intermediate mass range.

43654 (LBL—8859) **Operation of a high-current xenon source.** Chupp, W.; Clark, D.; Richter, R.; Staples, J.; Zajec, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 4p. (CONF-790327—108). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A multi-aperture Ehlers-type source has been constructed and operated to produce a 60 mA Xe^{+1} beam. The multi-aperture source utilizes a 13 hole aperture in a circular pattern producing a beam 25 mm in diameter. An accel—decel extraction system was used, producing a 22.5 keV beam whose normalized emittance at 29 mA was 0.027 π cm—mrad. The neutralized beam was transported one meter through two magnetic quadrupole triplets to the entrance of a 20 cm accelerating gap consisting of five intermediate electrodes with a total voltage drop of 500 kV. The vacuum in the extraction region was held to 10^{-5} Torr by usng a puff valve and two 1500 l/sec turbo pumps. Multi-wire profile monitors just ahead of the column entrance measured the beam size, which was in good agreement with single-particle transport calculations.

43655 **Laser scanning measurement of the density distribution of confined $^6Li^+$ ions.** Knight, R.D.; Prior, M.H. (University of California, Physics Department and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Appl. Phys.;* **50**: No. 5, 3044-3049(May 1979).

The density distribution of metastable 1s2s $^3S_1$ Li^+ ions confined in a radio-frequency quadrupole ion trap has been studied using a laser scanning technique. The laser beam, resonant with the 5485-A 1s2s $^3S_1$—1s2p $^3P_1$ transition, is scanned in a plane normal to the trap z axis. Intercombination photons, $1s^2\ ^1S_0$—1s 2p $^3P_1$ at 202 A, are counted and stored as a function of laser-beam position. Application of the Abel transform to the data gives the density profile in the plane of the scan. In all cases, the density profiles were consistent with a Gaussian distribution of ions. The radial and axial widths of the distribution were measured as a function of the number of ions and potential well depth and shape. The results are discussed in terms of a model in which the ions are in thermal equilibrium at a temperature of several thousand degrees Kelvin.

INJECTION AND EXTRACTION SYSTEMS

43656 (LA-UR—79-706) **Experience with the LAMPF Line D Fast Kicker System.** Thompson, M.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790327—52). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

In a paper presented at the 1977 Particle Accelerator Conference, R. Faulkner and R. Copper outlined the design of the LAMPF Line D Fast Kicker System. At that time the prototype had been constructed and initial tests were complete. After the Kicker was reassembled in final operating configuration, some components were extensively modified, and considerable operational experience has since been obtained. The system has now operated in production for over 500 hours. The Kicker is presently capable of delivering 7-μ-long pulses at a 120-Hz repetition rate with a peak current of 5800 A. It has operated for complete LAMPF production cycles without maintenance. Continued development work has concentrated on the high power load resistor, the pulse forming network (PFN) capacitor bank, the charging inductor, and the elimination of component failure caused by high voltage/current discharges. This paper discusses Kicker problem areas and solutions.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 43650, 43684

43657 (BNL—25509) **AGS capabilities and possible improvements.** Weng, W-T. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 9p. (CONF-781184—6). Dep. NTIS, PC A02/MF A01.

From Workshop on the AGS fixed target research program; Upton, NY, USA (8 Nov 1978).

This brief review gives a summary of both the current AGS capabilities and several possible improvements which either have been underway for awhile or are still at the stage of contemplation.

43658 (BNL—25775) **Distributed control system for the National Synchrotron Light Source.** Batchelor, K.; Culwick, B.B.; Goldstick, J.; Sheehan, J.; Smith, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-790327—136). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Until recently, accelerator and similar control systems have used modular interface hardware such as CAMAC or DATACON which translated digital computer commands transmitted over some data link into hardware device status and monitoring variables. Such modules possessed little more than local buffering capability in the processing of commands and data. The advent of the micro-processor has made available low cost small computers of significant computational capability. This paper describes how micro-computers including such micro-processors and associated memory, input/output devices and interrupt facilities have been incorporated into a distributed system for the control of the NSLS.

43659 (BNL—25776) **NSLS magnet system.** Galayda, J.; Heese, R.N.; Hsieh, H.C.H.; Kapfer, H. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—138). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

An overview of the National Synchrotron Light Source magnetic component system is given. Design parameters, construction methods and measurement procedures for the dipoles and multipole are presented for the storage rings and booster synchrotron.

43660 (BNL—25779) **Synchrotron radiation sources.** van Steenbergen, A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-790327—139). Dep. NTIS, MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Portions of document are illegible.

As a result of the exponential growth of the utilization of synchrotron radiation for research in the domain of the material sciences, atomic and molecular physics, biology and technology, a major construction activity has been generated towards new dedicated electron storage rings, designed optimally for synchrotron radiation applications, also, expansion programs are underway at the existing facilities, such as DORIS, SPEAR, and VEPP. In this report the basic properties of synchrotron radiation will be discussed, a short overview will be given of the existing and new facilities, some aspects of the optimization of a structure for a synchrotron radiation source will be discussed and the addition of wigglers and undulators for spectrum enhancement will be described. Finally, some parameters of an optimized synchrotron radiation source will be given.

43661 (BNL—25896) **Notes on the fast bus system.** Leipuner, L. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 4p. (CONF-780791—1). Dep. NTIS, PC A02/MF A01.

From ISABELLE summer workshop; Upton, NY, USA (17 Jul 1978).

In any system there will be modules that gather and process data from the experiment's detectors and perhaps from other sources such as the accelerator control system or monitoring system. In order to have a general system these modules must be able to communicate with each other and perhaps with a host computer or a group of controlling computers. A very general communications system is the bus system, used in computers, in which all devices are connected in parallel to a group of lines, typically 50 to 100. By means of a protocol of communication on some of these lines, a device that wants to control the bus makes its wishes known. If the device is the highest priority one currently asking for the bus, it gains bus mastership and then signals another device that it wants to communicate with by means of a set of address lines. This system works very well in a computer that includes a processor, memory, and peripheral devices; its disadvantage is that only one device can

be bus master at a time and only one communication can take place at a time. The proposed solution to this problem is to segment the bus so that each segment can operate independently without interfering with another one. This allows a large amount of parallel operation. It is, of course, necessary for one segment to communicate with other ones at some point in the process, and this is achieved by a device called the segment interconnect (SI). Much of the character of the system will be determined by the details of the SI. One possibility is a device that passes information only when the address falls within a band of values (or perhaps several bands); details of its specification are being worked on now.

43662 (CONF-790327—97) **Intense pulsed neutron source (IPNS-I) accelerator 500 MeV fast kickers.** Suddeth, D.E.; Volk, G.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-48. 4p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Portions of document are illegible.

Two ferrite loaded picture frame magnets with a kick of up to 15 mrad each are used to extract 500 MeV protons from the IPNS-I accelerator to the neutron source target at the Argonne National Laboratory. The magnet aperture is 10 cm wide by 5 cm high and the length is 60 cm. The single bunch extraction requires a magnetic field rise time (0 to 100%) of 90 ns and a flattop of 100 ns. The magnets receive the 3600 A maximum current via an array of 50 Ω coaxial cables connected in a shunt arrangement. The two legs of each magnet are energized with separate lines to keep the potential to ground to less than 40 kV. The system is designed to run at 30 pulses per second repetition rate. The complete system of control electronics, power supply, deuterium thyratron switch, magnet and resistive load will be described along with some of the problems of stray inductances and the techniques used to reduce them.

43663 (CONF-790327—126) **Transformer septum magnet.** Foss, M.; Thompson, K.; Praeg, W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A pulsed transformer septum magnet is under development for the Intense Pulsed Neutron Source (IPNS-I), 500 MeV accelerator. The septum consists of a copper sheet and a steel sheet. The copper sheet is one side of the shorted single turn transformer secondary. The steel sheet, which is on the stray field side of the septum, is part of the transformer core. External support and cooling structures, as well as the septum itself, can be grounded, which simplifies the design. The design construction and operation will be discussed. The transformer primary is driven by a condenser discharge. A reverse discharge a few ms later recharges the condenser and demagnetizes the septum. Details will be discussed.

43664 (CONF-790327—127) **Microprocessor-based control for independently-phased RF linac cavities.** Dawson, J.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A microprocessor based system has been built to control the RF amplifiers associated with independently phased linac cavities. The system has an 8080A at each amplifier station, together with associated ROM, RAM, I/O, etc. At a central NOVA 3 computer an additional 8080A system is incorporated in the interface to the NOVA I/O bus. The NOVA interface is connected by a bus of eighteen twisted pairs to each amplifier station, providing bilateral transmission between each station and the NOVA. The system architecture, bus protocol, and operating characteristics are described.

43665 (CONF-790327—128) **Preconceptual accelerator-breeder design for fissile material and energy production.** Lam, P.S.K. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A preconceptual accelerator-breeder design has been developed with improved capability to produce fissile material and thermal power. These improvements allow the design to have the dual role of fissile material and electricity production.

43666 (CONF-790327—130) **Common anode amplifier development.** Hardek, T.W.; Chyna, W.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

As accelerator beam intensity increases, loading of the RF system becomes a serious problem. Typical solutions include careful accelerating cavity design and active feedback schemes. Since the goal is to provide a low accelerating gap impedance, it is possible to simply drive the gap with a low output impedance amplifier. The common anode (also called cathode follower) configuration seems to be ideally suited for such an amplifier but has not received much attention in high power amplifier applications. This paper describes the construction and testing program of high power common anode configured RF amplifiers carried out at the Zero Gradient Synchrotron (ZGS). While amplifiers of this type seem limited to lower frequency accelerator applications, they may prove to be a viable alternative to the more conventional approaches currently in use.

43667 (CONF-790327—132) **Rapid cycling synchrotron magnet with separate ac and dc circuit.** Burke, R.J.; Foss, M.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

In present rapid cycling synchrotron magnets ac and dc currents flow in the same coil to give the desired field. The circuit reactance is made zero at dc and the operating frequency by running the magnet in series with an external parallel resonant LC current. We propose to return the ac flux in a gap next to the synchrotron. The dc coil encloses the ac magnetic circuit and thus links no ac flux. A shorted turn between the dc coil and ac flux enhances the separation of the two circuits. Several interesting developments are possible. The dc coil could be a stable superconductor to save power. The ac flux return gap could be identical with the synchrotron gap and contain a second synchrotron. This would double the output of the system. If the return flux gap were used for a booster, the ac coil power could be greatly reduced or radiation hardening of the ac coil could be simplified.

43668 (CONF-790327—133) **Buncher cavity resonant at the first and second harmonic.** Foss, M.H. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A buncher is an RF accelerator followed by a drift space. Its purpose is to bunch the dc ion source beam into suitable bunches for acceleration in a linac. The voltage in a simple buncher is a sine wave at the linac frequency. A more elaborate wave form can result in increased capture of ion source beam. The cavities discussed here are resonant at 12.5 and 25 MHz, the first and second harmonic of the Argonne National Laboratory (ANL) low beta linac. They will support a wave form which should give improved bunching. Three designs are given to compare their relative merits.

43669 (CONF-790327—134) **Minus-I quadrupole system for containing aberration-correction octupoles.** Fenster, S. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Octupoles may be used to correct the third order spherical aberration of quadrupole transport systems. Crosstalk in the coupling of an octupole placed at a given point causes it to add a term with the wrong sign in the y-channel if it has the right sign in the x-channel, thus severely reducing efficiency. It is often convenient to utilize a special correcting section insertion which is seen as a +I transfer matrix by the first order focusing. Within point-to-point thin lens optics we give two-parameter systems with 16 magnets having locations with large S/sub x/ where S/sub y/ = 0 and vice versa for octupole placement.

43670 (COO—3071-239) **Modular calorimeter system for use in high energy physics.** Yost, B.T.; Corcoran, M.D.; Cormell, L. (Fermi National Accelerator Lab., Batavia, IL (USA); Lehigh Univ., Bethlehem, PA (USA); Pennsylvania Univ., Philadelphia (USA); Wisconsin Univ., Milwaukee (USA)). Oct 1978. Contract EY-76-C-02-3071. 18p. (CONF-781033—45). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

A modular hadron calorimeter was designed and built for the study of high energy particle interactions which produce particles of high transverse momentum. The energy resolution of this system and the triggering method for selecting the interactions of interest are described.

43671 (LA-UR—79-1236) **Meson factories.** Dicello, J.F.; Zaider, M.; Bradbury, J.N. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790524—4). Dep. NTIS, PC A02/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

Technological improvements in accelerator design in the 1960's resulted in the capability to develop medium-energy proton

accelerators with beam intensities of almost 1 mA. These beams are able to produce fluxes of secondary particles, including pions, muons, neutrinos, and neutrons, which are as much as 10,000 times as intense as those previously available. Those machines built for optimum meson production are commonly called meson factories. The characteristics of these facilities are reviewed, and the present programs in applied research, and some potential areas of future work are discussed.

43672 (LBL—8414) **Hardware implementation and test results of PEP chopper magnet power supply system.** Jackson, L.T.; Flood, W.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 6p. (CONF-790327—144). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Emphasis is placed on the hardware that has been produced and any changes that have occurred in the major technical components. At the time of the conference all of the Injection and Beam transport system is installed and beam has been run down the South Injection tunnel two-thirds of the way to the ring. The chopper system for powering the Ring Bend, Quadrupole, and Sextupole circuits is prepared for installation when the region 8 surface building is available for occupancy in early April, 1979. The last major system, the bipolar Trim and Steering supply system is partially completed and orders for the remainder are now being placed for delivery in June, 1979. The following sections will describe each of the systems in more detail.

43673 (SAND—79-0615C) **High energy neutron sources using pulsed ion beam accelerators.** Bolduc, P.E.; Kruse, L.W.; Hanson, D.L.; Beezhold, W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-790706—4). Dep. NTIS, PC A02/MF A01.

From 1979 IEEE Annual conference on nuclear and space radiation effects; Santa Cruz, CA, USA (17 Jul 1979).

A new high energy ($1 < E < 10$ MeV) neutron source based on existing pulsed Sandia accelerators operated in the ion mode is described. In addition to its application in weapons effects testing, this source could be used in studying transient annealing effects at high neutron energies and for calibration of semiconductor damage curves. Finally, such a pulsed neutron source makes it possible to begin dose rate damage effect studies in ICF reactor materials.

43674 (SLAC-PUB—2268) **Device to measure quadrupole gradient-length product.** Reagan, D. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 3p. (CONF-790327—121). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

This instrument measures the focusing strength, $\int$ gdz, of a quadrupole by moving a bundle of wires across its bore and recording the integrals of the two voltage loops generated by each stroke, together with the length of the stroke. A discussion of errors is given that indicates that it is possible to do 0.01% measurements upon electromagnets of moderately good quality with the device if amplitudes and phases of non-quadrupole field components are known from other measurements. 2 figures.

43675 (SLAC-PUB—2290) **Next generation of accelerators.** Richter, B. (Stanford Linear Accelerator Center, CA (USA)). 1979. Contract EY-76-C-03-0515. 6p. (CONF-790327—145). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Existing high-energy accelerators are reviewed, along with those under construction or being designed. Finally, some of the physics issues which go into setting machine parameters, and some of the features of the design of next generation electron and proton machines are discussed. (GHT)

43676 (TRI-PP—79-3) **New facilities and kaon factory designs for TRIUMF.** Craddock, M.K. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Mar 1979. 10p. (CONF-790347—9). TIC.

From 2. international conference on meson-nuclear physics; Houston, TX, USA (5 Mar 1979).

The TRIUMF 520 MeV H^- cyclotron came into operation in December 1974 and first delivered a 100 μA beam in July 1977. Facilities recently commissioned include a second-proton line for polarized and high resolution experiments (single turn extraction has been demonstrated at 200 MeV), a pion spectrometer, a 70/90 MeV proton beam for isotope production and a new slow ($\leqq$ chemical bond 30 MeV/c) pion/muon channel. Major projects under way include a high-resolution fast pion channel, dc and rf separators to give purer stopping muon beams, and a time projection chamber. Further in the future are the possibilities of building a third (simultaneous) 400 to 500 MeV proton beam and high-flux muon and biomedical π^- channels. More fascinating still is the possibility of elevating TRIUMF from a pion to a kaon factory, producing currents 100 to 1000 times more intense than those at present available in the GeV range. Two post-accelerator designs are being considered - a 30 μA rapid cycling 8 to 10 GeV proton synchrotron (which could in turn inject into a higher-energy machine) - and a 400 μA isochronous ring-cyclotron built in two stages, the first to 3 GeV and the second to 8.5 GeV.

43677 (TRI-PP—79-4) **TRIUMF thermal neutron facility.** Burgerjon, J.J.; Arrott, A.S.; Thorson, I.M.; Templeton, T.L.; Hodges, T.A.; Blaby, R.E.; Langstaff, R.R. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility; Simon Fraser Univ., Burnaby, British Columbia (Canada); Victoria Univ., British Columbia (Canada)). Mar 1979. 4p. (CONF-790327—140). TIC.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The beam stop for the 500 MeV, 100 μA beam from the TRIUMF cyclotron has been optimized to provide a variety of facilities for fundamental and applied research. These include: facilities for irradiating specimens with high-energy protons for research and for isotope production; facilities for irradiating specimens with neutrons of all energies from thermal to 500 MeV; and collimated neutron beams from the assembly core, primarily of thermal energies but also of epithermal and higher energies. The combination of these facilities in one unit has resulted in a compact design with substantial savings in shielding and space. The unit consists of a molten lead stopping target surrounded by a H_2O/D_2O moderator, an H_2O reflector and iron and concrete shielding. Most of the beam power (50 kW) is transferred by natural convection in the molten lead to the target wall. From there it is transferred by nucleate boiling to the surrounding H_2O moderator. Subsequently the heat is transferred by natural convection to a heat exchanger coil in the upper half of the moderator tank. The facility was commissioned early in 1978. This paper discusses design details, operational experience and measured neutron fluxes and activation levels.

43678 (TRI-PP—79-5) **rf impedance of the accelerating beam gap and its significance to the TRIUMF rf system.** Poirier, R. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Mar 1979. 3p. (CONF-790327—142). TIC.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The rf system at TRIUMF is now operating with the highest Q, the lowest rf leakage into the beam gap, the best voltage stability, and the lowest resonator strongback temperatures ever measured since it was first put into operation. This paper describes the calculation of the rf impedance of the beam gap and its correlation to the rf problems encountered, which eventually led to modifications to the flux guides and resonator tips to accomplish the improved operation of the rf system.

43679 **Targets for heavy ion beams.** Yntema, J.L. (Argonne National Lab., IL); Nickel, F. pp 206-235 of Experimental methods in heavy ion physics. Bethge, K. (ed.). New York, NY; Springer-Verlag (1978).

The effect of heavy ion bombardment of target foils is reviewed. Topics covered include: carbon stripper foils; target damage and target lifetime; sputtering; target temperature; evaporation; temperature calculations; temperature measurement; and target uniformity; (GHT)

STORAGE RINGS

REFER ALSO TO CITATION(S) 43647

43680 (BNL—25777) **National synchrotron light source VUV storage ring.** Blumberg, L.; Bittner, J.; Galayda, J.; Heese, R.; Krinsky, S.; Schuchman, J.; van Steenbergen, A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-790327—137). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A 700 MeV electron storage ring designed for synchrotron radiation applications is described. Lattice and stability calculations are presented and the vacuum, correction and injection systems are discussed.

43681 (BNL—50980) **Average neutralization and transverse stability in ISABELLE.** Herrera, J.; Zotter, B. (Brookhaven National Lab., Upton, NY (USA)). 15 Dec 1978. Contract EY-76-C-02-0016. 12p. Dep. NTIS, PC A02/MF A01.

Clearing of electrons in the vicinity of the axis of a proton beam in the dipoles of a separated function AG-focusing structure is accomplished by transverse crossed-field drift due to the magnetic dipole field and a weak longitudinal electric field. This electric field

is generated by potential differences caused by cross section variations of the beam due to variations of the β-functions and dispersion. The resulting radial drift brings the electrons into the off-axis region where they are driven out of the magnets by the usual longitudinal cross-field drift caused by the radial space charge field. The neutralization in ISABELLE is then a factor 20 below former estimates, and transverse stability can be obtained by chromaticity adjustments well within the design strengths of the sextupole correction windings.

43682 (LBL—8340) **PEP insertion quadrupole design features.** Avery, R.T.; Chan, T.; Halbach, K.; Main, R.; Tanabe, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 7p. (CONF-790327—146; PEP—291). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

The insertion quadrupoles for the PEP storage ring must have a very uniform gradient to focus the circulating beams to a very small size at the interaction point for high luminosity. Quads have been built which achieve the desired field within the full pole aperture radius to approximately one part in 10^4. The design features which permitted this achievement are described.

43683 (LBL—8397) **Superconducting proton storage ring for PEP.** Garren, A.A.; Molishever, E.L.; Peterson, J.M.; Sah, R.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 6p. (CONF-790327—148). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

In order to provide for electron-proton collisions in the PEP system, plans for a high-energy superconducting proton storage ring are being explored. The energy is constrained to 300 GeV by the radius of the PEP tunnel (350 meters) and the field strength (7 tesla) expected to be available in practical superconducting magnets. A new configuration has been developed in which the proton ring vertically crosses the horizontal electron ring in 4 of the 6 straight-sections. Synchronization of the two beams is provided by means of bypasses in the two non-crossing straight sections in the electron ring. The proton injector is a 5 GeV/c synchrotron 1/18 as large as the main ring.

43684 (LBL—8412) **PEP Laser Surveying System.** Lauritzen, T.; Sah, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 7p. (CONF-790327—147). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

A Laser Surveying System has been developed to survey the beam elements of the PEP storage ring. This system provides automatic data acquisition and analysis in order to increase survey speed and to minimize operator error. Two special instruments, the Automatic Readout Micrometer and the Small Automatic Micrometer, have been built for measuring the locations of fiducial points on beam elements with respect to the light beam from a laser. These instruments automatically encode offset distances and read them into the memory of an on-line computer. Distances along the beam line are automatically encoded with a third instrument, the Automatic Readout Tape Unit. When measurements of several beam elements have been taken, the on-line computer analyzes the measured data, compared them with desired parameters, and calculates the required adjustments to beam element support stands.

43685 (SLAC-PUB—2284) **Bench measurements of the loss impedance for PEP beam line components.** Weaver, J.N.; Wilson, P.B.; Styles, J.B. (Stanford Linear Accelerator Center, CA (USA)). Mar 1979. Contract EY-76-C-03-0515. 4p. (CONF-790327—112). Dep. NTIS, PC A02/MF A01.

From IEEE particle accelerator conference; San Francisco, CA, USA (12 Mar 1979).

Bench measurements of the parasitic model loss parameter k, due to the interaction of a bunched beam with discontinuities in the vacuum pipe, are presented for many of the PEP beamline components. The measurements were made using the pulsed, coaxial transmission method of Sands and Rees. Full-scale machined and sheet metal models containing tapers, gaps, tanks (cavities) collimators, plates, electrodes and other irregular shapes were investigated. Accuracies, errors and modeling difficulties are pointed out. Loss curves and rules of thumb are discussed that should aid in the design of similar components. Also described is a moderately successful effort to de-Q some of the resonances in a particularly complicated chamber (separating plates) with a strip line coupling loop that is externally terminated at both ends.

43686 (UCRL-Trans—1555) **Stochastic effects in the interaction of colliding beams.** Vasserman, I.B.; Izrailev, F.M.; Mishnev, S.I.; Tumaikin, G.M. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Sep 1978. Translation of 10th international conference on high energy accelerators, Serpukhov, USSR, July 11—17, 1977, proceedings, pp 302-307. (CONF-770709—24(trans)). 14p. Dep. NTIS, PC A02/MF A01.

From 10. international conference on high energy accelerators; Serpukhov, USSR (11 Jul 1977).

The electromagnetic interaction of colliding beams in a storage device leads to an increase in the transverse beam dimensions and to the loss of particles. The nonlinear electromagnetic field of the bunch shifts the betatron frequency of the colliding particle; the shift depends on the oscillation amplitude. The periodic azimuthal dependence of the strength of this field results in the excitation of nonlinear resonances. If the current in the colliding beam increases, the number of resonances increases in that region of the phase plane occupied by particles; the stable phase regions of neighboring resonances become larger and start to overlap. Chirikov has examined the general features of particle motion under these conditions, showing that when the resonances overlap the motion on part of the phase plane is stochastic in nature. In the case of frequency modulation of the betatron oscillations (e.g., by synchrotron oscillations), the picture becomes more complicated. Depending on the relation among the frequency deviation, the modulation frequency, and the frequency of the oscillations in the stable phase region, the periodic intersection of the resonance may yield new effects; in particular, it may lower the threshold for the overlapping of resonances. The collision effects have been studied numerically and analytically. Nonetheless, the basic problem is still to define the most important factors that reduce the critical values of the colliding-beam currents. With this aim, a numerical and experimental investigation of collision effects was carried out over a wide range of conditions, and how the stochasticity criterion depends on the various parameters was determined.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 42894, 42950, 43884

43687 (CONF-780783—1) **Analysis of factors limiting the geometric resolution of a positron imaging device.** Atkins, F.B.; Harper, P.V.; Beck, R.N. (Chicago Univ., IL (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, IL (USA)). 1978. Contract EY-76-C-02-0069. 25p. Dep. NTIS, PC A02/MF A01.

From 20. American Association of Physicists in Medicine annual meeting; San Francisco, CA, USA (30 Jul 1978).

Large-area, positron-sensitive detectors are used in annihilation coincidence systems for studies with positron-decay radiopharmaceuticals. Factors which limit the spatial resolution in such systems are analyzed. These factors include: (1) the intrinsic spatial resolution of the detector, (2) parallax errors, (3) range of positrons in tissue, and (4) angular deviation of the coincident photon pair from colinearity.

43688 (UCRL—52651) **Calculations of the transverse spatial distribution of NE102 scintillation light made by recoil protons from collimated 14-MeV neutrons.** Goosman, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jan 1979. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

A calculation has been made of the spatial distribution of NE102 scintillation light produced by recoil protons from collimated 14-MeV neutron illumination. Results were then averaged over offset circles of various radii, thus determining the fraction of the total scintillation light created inside cylindrical scintillators for uniform neutron illumination over the front face of the scintillator. The results are useful in sensitivity considerations for neutron-imaging camera design.

43689 **ISEE-C solar wind plasma experiment.** Bame, S.J.; Asbridge, J.R.; Felthauser, H.E.; Glore, J.P.; Hawk, H.L.; Chavz, J. (Univ of Calif, Los Alamos Sci Lab, NM). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 3, 160-162(Jul 1978).

Two 135° spherical section electrostatic analyzers furnish electron and ion measurements of the solar wind on the ISEE-C spacecraft. Each instrument utilizes a divided secondary emitter system to intercept the analyzed particles. Secondary electrons selected from all emitters simultaneously provide fast two-dimensional measurements of the particle fluxes integrated over a polar angle; at a slower rate secondary electrons are successively selected from individual emitters to provide three-dimensional measurements.

Speed of the ion measurements is increased by a factor of two by using an active proton peak tracking system to reduce the total range of energy per charge which has to be covered.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 42907, 43041

43690 Method for measuring dose-equivalent in a neutron flux with an unknown energy spectra and means for carrying out that method. Distenfeld, C.H. (to Dept. of Energy). US Patent 4,100,414. 11 Jul 1978. Filed date 19 Jan 1977. 8p.

PAT-APPL-760,796.

Disclosed is a method for measuring the dose-equivalent for exposure to an unknown and/or time varying neutron flux which comprises simultaneously exposing a plurality of neutron detecting elements of different types to a neutron flux and combining the measured responses of the various detecting elements by means of a function, whose value is an approximate measure of the dose-equivalent, which is substantially independent of the energy spectra of the flux. Also, a personnel neutron dosimeter, which is useful in carrying out the above method, comprising a plurality of various neutron detecting elements in a single housing suitable for personnel to wear while working in a radiation area.

43691 Polystyrene-rare earth phosphor scintillation dosimeter. Boston, T.L. Gainesville, FL; Univ. of Florida (1978). 128p. University Microfilms Order No. 7907726.

Thesis (Ph. D.).

The purpose of this research was to improve measuring techniques in high energy electron and photon therapy with regard to increasing accuracy and simplification of procedure by producing a dosimeter whose energy response was directly proportional to the energy deposition in water. Thirteen polystyrene—rare earth phosphor scintillation dosimeters were constructed and evaluated for a wide range of electron and photon energies. The dosimeters were made water-equivalent by mixing polystyrene and rare earth phosphors in theoretically determined proportions. Response of the dosimeters were evaluated with currently available theory and experimental results were compared to air ionization chamber and Fricke dosimeter measurements. The dosimeters are: (1) temperature and pressure independent in normal clinical operation; (2) simpler to use for electron dosimetry than currently available dosimeters; and (3) totally solid state eliminating long term instabilities. The polystyrene—rare earth phosphor scintillation dosimeter enables accurate and reproducible measurements to be made and reduces the chance of possible error presently existing in accepted protocols.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 43880

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 43670

43692 (COO—2114-30) **Cell structure for the MAC central drift chamber.** Ford, W.T. (Colorado Univ., Boulder (USA)). 17 May 1978. Contract EY-76-C-02-2114. 8p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

An analysis of the electrostatics and electron transport characteristics of various drift cell designs was performed in order to optimize the detector configuration. The conclusions reached from these computer studies are presented.

43693 (LBL—8136) **Multichannel analog to digital converter and readout system for the time projection chamber.** Maier, M.R.; Olson, S.R.; Nakamura, M.; Goulding, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1978. Contract W-7405-ENG-48. 9p. (CONF-781033—43). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

The Time Projection Chamber (TPC) project involves the characterization of signals arriving at approximately 20,000 separate detector wires and pad electrodes. The characterizaton requires measurement of the signal amplitudes in 100 ns time slices over a total time of 20 μs (the total chamber drift time). Charge Coupled Devices (CCD's) are used to store an image of the 20 μs span of signals and the image is played back at a low rate (50 μs time slices, i.e., a time expansion of 500:1). Digitization of the 20,000 parallel signals at the output of the CCD's must therefore be accomplished in 50 μs and readout of digital data into the computer system must also be accomplished in this time. Many zeros occur in the data, a fact which reduces the data handling demands on the readout system, but does not reduce the stringent requirements on the digitizer. Therefore, the requirements on the digitizer are highlighted by the need to perform 9-bit digitizing in less than 50 μs. Furthermoree, a double buffering scheme must be used to permit interleaving digitizing and digital readout cycles. A description is given of the implementation of this concept and some possible applications for other experiments which require many Analog to Digital Converter (ADC) channels.

43694 Possibility of producing a bulky supersensitive thermal detector at a temperature close to absolute zero. Neganov, B.S.; Trofimov, V.N. (Joint Institute for Nuclear Research). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 328-329(20 Sep 1978).

The possibility is discussed of using a large-mass system, cooled to infralow temperatures ($<$ or $=1$ K) and insulated, as an ultrasensitive detector of energy-releasing interactions with fields and particles. The detectors register the change of the system temperature. The necessary condition for the realization of high sensitivity (10^{-22} W/g at $T<0.01$ K) is a decrease of the inflow of parasitic heat due to mechanical vibrations, to electromagnetic induction, and to the cosmic and natural-radioactivity background. The principal results of an investigation at 1 K are reported. It is observed that the main obstacle to the development of the detector may be the reversible effect of thermal relaxation in the detector material after the cooling.

43695 ISEE-C HKH high energy cosmic rays. Greiner, D.E.; Bieser, F.S.; Heckman, .H.H. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 3, 163-165(Jul 1978).

A satellite-borne multidetector cosmic ray telescope experiment is described. This package is designed to identify the charge and mass of incident cosmic ray nuclei from ^{1}H to ^{64}Ni over the energy range from 20 to 50 MeV/nucleon. Particle identification is based on the multiple energy loss technique. The experiment will thus measure the isotopic abundances of the cosmic ray flux and provide essential information to help understand the origin of high-energy cosmic rays.

RADIOMETRIC INSTRUMENTS

43696 Application of computed tomography, boundary detection, and shaded graphics reconstruction to industrial inspection. Kruger, R.P.; Cannon, T.M. Contract W-7405-ENG-36. *Mater. Eval.;* **36**: No. 5, vp(Apr 1978).

Work has begun which explores the use of Computed Axial Tomography (CAT), boundary detection, and internal surface reconstruction techniques in industrial nondestructive testing applications. This initial work is intended to inform the reader of the existence and interrelated nature of these techniques through the use of a realistic simulation of an industrial inspection problem.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

43697 (LBL—8307) **Radiation damage resistance of reverse electrode ge coaxial detectors.** Pehl, R.H.; Madden, N.W.; Elliott, J.H.; Raudorf, T.W.; Trammell, R.C.; Darken, L.S. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1978. Contract W-7405-ENG-48. 12p. (CONF-781033—41). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

Two high-purity germanium coaxial detectors, having opposite electrode configurations from one another, but fabricated from the same germanium crystal, were irradiated simultaneously with fast neutrons from an unmoderated ^{252}Cf source. Both detectors were 42 mm diam. The detector having the conventional electrode configuration was about 28 times more sensitive to radiaion damage than was the detector havng the p^{+} contact on the coaxial periphery. These results prove that germanium coaxial detectors having the conventional electrode configuration should not be used in any situation subject to significant radiaiton damage. This conslusion was anticipated because the defects produced by neutron and proton irradiaiton of germanium act predominantly as hole traps.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 42185, 42187, 42192, 42954, 42968, 42994, 43674, 43715, 43776, 43851

43698 (CONF-790505—7) **Interpreting two state instruments for intermediary values.** Good, R.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 9p. Dep. NTIS, PC A02/MF A01.

From 25. ISA international instrumentation symposium; Anaheim, CA, USA (7 May 1979).

Interpolating data from instruments which produce only two distinct binary outputs is discussed. The problem of determining void fraction, given an instrument which produces only a liquid or a no-liquid output, is used to demonstrate three different methods of data interpolation. The three methods involve a form of time averaging. The methods are signal amplitude histogram, signal derivative, and signal derivative discriminator. The advantages, disadvantages, and accuracies of each method are described.

43699 (LA—7562) **Low-noise audio amplifiers and preamplifier for use with intrinsic thermocouples.** Langner, G.C.; Sachs, R.D.; Stewart, F.L. (Los Alamos Scientific Lab., NM (USA)). Mar 1979. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

Two simple, low-noise audio amplifiers and one low-noise preamplifier for use with intrinsic thermocouples were designed, built, and tested. The amplifiers and the preamplifier have different front end designs. One amplifier uses ultralow-noise operational amplifiers; the other amplifier uses a hybrid component. The preamplifier uses ultralow-noise discrete components. The amplifiers' equivalent noise inputs, at maximum gain, are 4.09 nV and 50 nV; the preamplifier's input is 4.05 μV. Their bandwidths are 15 600 Hz, 550 Hz, and 174 kHz, respectively. the amplifiers' equivalent noise inputs were measured from ~ 0 to 100 Hz, whereas the preamplifier's equivalent noise input was measured from ~ 0 to 174 kHz.

43700 (LBL—7590) **Wide-band measuring system for studying charge-coupled device characteristics.** Leskovar, B.; Lo, C.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 8p. (CONF-781033—38). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Washington, DC, USA (18 Oct 1978).

A wide-band four-channel measuring system has been developed for studying charge-coupled devices and optimizing their characteristics. The system incorporates a high-to-low frequency processor capable of handling the 100 to 300 MHz high frequency clock CCD driver and generating the 0.5 to 10 MHz readout frequency, a microwave component based on a four-phase signal generator, a four-channel phase-matched RF power amplifier and a wide-band CCD test fixture. The phase error between the four low frequency channels is less than +- 5 degrees through the 1 to 10 MHz band, and less than +- 10 degrees in the 100 to 250 MHz range. The measuring system is capable of delivering an output voltage of 10 V peak-to-peak up to frequencies of 280 MHz and 170 MHz into a capacitative load of 25 pF and 100 pF, respectively.

43701 (LBL—8738) **Position sensors and actuators for figure control of a segmented mirror telescope.** Gabor, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 17p. (CONF-790147—1). Dep. NTIS, PC A02/MF A01.

From Society of photo-optical instrumentation engineers, instrumentation in Astronomy III symposium; Tucson, AZ, USA (29 Jan 1979).

A control system using mirror displacement sensors and position actuators to maintain proper surface control of a segmented mirror is summarized. The system is composed of three major components; a figure control computer, displacement sensors and displacement actuators. Desired positioning accuracy is 50 nm. Several methods for achieving the needed sensor sensitivity and stability are discussed. A capacitive bridge detector was chosen and its expected and measured behavior is described. Two mechanisms for positioning a mirror segment to optical tolerances, yet having a large dynamic range to compensate for mirror cell deformation are reviewed. Test results for a roller screw are given with an outline of the servo loop design.

43702 (SAND—79-0053) **Evaluation of the Omni Spectra Model 100 microwave motion detection system.** Williams, J.D. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract AC04-76DP00789. 56p. Dep. NTIS, PC A04/MF A01.

A series of tests were performed on the Omni Spectra Model 100 motion detection system. The primary objectives of these tests were to determine sensor detection patterns and to quantitate the effects of intruder velocity. System susceptibility to fluorescent lights, oscillatory motion, and environmental factors was also examined.

43703 (SAND—79-0412C) **Roadrunner: a novel radar guidance concept.** Kelsey, J.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-790536—1). Dep. NTIS, PC A02/MF A01.

From 2. Echelon armor interdiction symposium; Chicago, IL, USA (1 May 1979).

Soviet breakthrough tactics require the movement of a large number of vehicles from assembly areas to the forward edge of the battle area. The time requirements of this tactic indicate that the road network must be used extensively, if not exclusively. This paper describes an exploratory development (technology demonstration) program aimed at demonstrating a novel radar navigation/guidance scheme which enables a small unmanned aircraft (drone) to follow roads. Since vehicles on the road can be easily detected, this aircraft could be used as either a strike vehicle itself or as a reconnaissance adjunct to another strike system. The guidance scheme involves on-board radar measurements of the backscatter response of the terrain beneath the aircraft. The differences in reflectivity between road and roadside surfaces are processed by a small on-board computer to generate guidance commands to keep the vehicle over the road. Preliminary system definition includes a 17-GHz radar aboard a subsonic, propeller-driven unmanned aircraft. Estimated operational altitude and speed are 30 m and 100 km/h, respectively. The drone could be either ground or air launched, and would be expendable. Payload capabilities of 50 to 100 kg are envisioned, with an operational range of 50 to 100 km. 5 figures, 1 table.

43704 **Improved servo-polarimeter.** Primak, W.; Monahan, E. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *Rev. Sci. Instrum.;* **50**: No. 6, 738-740(Jun 1979).

A servo-polarimeter utilizing a rotating plastic film as a modulator has been modified to improve stability and sensitivity. The birefringence in a sample being scanned by moving it past a slit can now be determined to better than 3 x 10^{-9}.

43705 **Use of synchrotron radiation for the measurement of fluorescence lifetimes with subpicosecond resolution.** Gratton, E.; Delgado, R.L. (Department of Physics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Rev. Sci. Instrum.;* **50**: No. 6, 789-790(Jun 1979).

A method for the measurement of fluorescence lifetimes with subpicosecond resolution is described. The temporal resolution is achieved by using the high harmonic content of the synchrotron radiation produced by an electron storage ring.

43706 (BDX—613-2128) **Microhm resistance measurements to determine plating thickness on PWB.** Abel, W.B. (Bendix Corp., Kansas City, MO (USA)). [nd]. Contract EY-76-C-04-0613. 7p. (CONF-790103—1). Dep. NTIS, PC A02/MF A01.

From Plating in electronics industry symposium; San Francisco, CA, USA (16 Jan 1979).

The Bendix Corporation, Kansas City Division has been involved in an effort to improve and extend the usee of microresistance testing for the evaluation of copper plating quality and thickness on printed circuit boards. This activity has concentrated on three applications: measurement of the copper plating thickness on the surface of panel plated boards; conductor thickness of pattern plated boards; and the evaluation of plated through holes. The nature of this activity, the equipment used in making these measurements and some of the data which has been observed with these methods are described and presented.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 42351, 43862, 43863

43707 (COO—3158-64) **Specimen-exchange device for an ultra-high vacuum atom-probe field-ion microscope.** Wagner, A.; Hall, T.M.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering; Cornell Univ., Ithaca, NY (USA). Materials Science Center). Jul 1978. Contract EY-76-S-02-3158. 10p. Dep. NTIS, PC A02/MF A01.

A specimen-exchange device is described for an ultra-high vacuum field-ion microscope (FIM). This device completely eliminates the long pump-down period that is required if the FIM chamber is brought back to atmospheric pressure. The pressure in an air-lock is reduced to 10^{-6} Torr before the exchange takes place and the pressure in the FIM chamber remains below 10^{-7} Torr during the exchange and it drops to less than 3 x 10^{-9} Torr within 15 minutes after the exchange.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 42255, 43586, 43852

43708 (MHSMP—79-7) **PBX 9502 coupon test.** Myers, L.C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)).

Apr 1979. Contract EY-76-C-04-0487. 30p. Dep. NTIS, PC A03/MF A01.

PBX 9502 is a plastic-bonded explosive composed of 95/5 wt% of triaminotrinitrobenzene (TATB) and Kel-F 800, respectively. The coupon test is an accelerated aging test which is being used to investigate what effects low and high levels of chlorine impurities in the TATB will have on other weapon materials. The testing techniques used to evaluate the degradation of the materials in this test are discussed. Some corrosion occurred in the coupon assemblies which were conditioned at 100°C. Rust was observed on the 304 stainless steel and one of the assemblies, the uranium/niobium disc, showed some corrosion. The polymeric spring showed some compression set. The amount of set decreased with temperature. A change was observed in the mechanical properties of the PBX 9502.

43709 (NP—23780) **Impact sensitivity tests.** Yoshida, T.; Tamura, M.; Yoshida, M. (Tokyo Univ. (Japan). Faculty of Engineering). 5 Apr 1978. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Various test methods for mechanical impact sensitivity are reviewed with special attention to such topics as drop hammer tests for desensitized explosives, judgement of test results, composition of decomposition gases from drop hammer tests, correlation of the test results with other data, skid tests, impact tests for detonators, modelling of ignition by mechanical impact and application of statistical techniques to the evaluation of sensitivity.

43710 (UCID—18026) **Selected sensitivity tests of Triaminotrinitrobenzene (TATB) and TATB formulations and their evaluation.** Dobratz, B.M.; Finger, M.; Green, L.G.; Humphrey, J.R.; McGuire, R.R.; Rizzo, H.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Mar 1979. Contract W-7405-ENG-48. 184p. Dep. NTIS, PC A09/MF A01.

The sensitivity and hazards tests performed on TATB and TATB-containing explosive formulations are summarized and evaluated. TATB is exceedingly insensitive. TATB and its compositions react much less violently, if at all, to thermal, mechanical, and electrical stimuli than common plastic-bonded explosives, and also require a higher-than-usual-amplitude shock wave to initiate detonation.

43711 (UCRL—50025-79-1, pp 24-29) **Modifications to the LeBlond precision lathe improves safety in machining high explosives.** 30 Mar 1979.

In Electronics engineering department. Quarterly report No. 1, 1979.

In machining high explosives, three major concerns are safety, reliability, and ease of operation. With these concerns as the main goals, a LeBlond precision lathe for machining high explosives was modified. The result is a unique remote-controlled lathe that shortens downtime, improves accuracy, and reduces interferences from other operations. Since April 1978, the lathe has been operating successfully and safely at LLL's high explosive test facility at Site 300.

43712 (NP-tr—23781) **Heat sensitivity tests.** Yoshida, T.; Tamura, M.; Itoh, M. Translated from *Kogyo Kayaku;* **39**: No. 3, 106(1978). 24p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Various heat sensitivity tests for evaluating hazardous phenomena, such as spontaneous ignition, ignition by heat sources, violence of decomposition and combustion, transition from deflagration to detonation and hazards involved in mixing reactive chemicals are reviewed.

NUCLEAR

43713 (AD-A—059939) **Material properties of Nevada Test Site tuff and grout--with emphasis on the Diablo Hawk and Hybla Gold events. Final report 1 aug 76-30 sep 77.** Gardiner, D.S.; Enniss, D.O.; Butters, S.W.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Nov 1977. Contract DNA001-76-C-0351. 273p. NTIS PC A12/MF A01.

The primary task during this period was material evaluations for the Diablo Hawk and Hybla Gold events. Tuff, grout, concrete, saturated sand and reconstituted tuff were tested. The material evaluations are used for initial nuclear test site selection, detailed site evaluation (for purposes of insuring successful stemming and containment) and support of related experiments. The majority of the tests were uniaxial strain tests with accompanying physical property and ultrasonic velocity measurements. Additionally, hydrostatic and triaxial compression, heat transfer, burst, and permeability tests were conducted.

43714 (AD-A—059940) **Quick estimates of peak overpressure from two simultaneous blast waves. Topical report oct-dec 77.** Brode, H.L. (R and D Associates, Santa Monica, CA (USA)). Dec 1977. Contract DNA001-78-C-0009. 44p. NTIS PC A03/MF A01.

Several simple approximations to the peak overpressure between two interacting (simultaneous) blast waves are explored and compared to the LAMB approximation method for multibursts. The best estimates suggest about a 30% (10%-50%) increase in line-target coverage over that covered by two nonsimultaneous bursts. Coverage is restricted to strong shocks (Delta-P > 100 psi).

43715 (EGG—1183-1634) **Measurement system for large motions.** Noyes, R.; Davies, L.; Kalinowski, J.; Stubbs, T. (EG and G, Inc., Las Vegas, NV (USA); EG and G, Inc., San Ramon, CA (USA)). May 1979. Contract EY-76-C-08-1183. 18p. Dep. NTIS, PC A02/MF A01.

The system used to measure the response of geologic media to stress waves generated during and after underground tests performed by the Lawrence Livermore Laboratory (LLL) at the Department of Energy's Nevada Test Site (NTS) is described. Included are descriptions of the system transducers and accelerometers, the procedures used in calibrating and packaging the system at the North Las Vegas Facility of EG & G, Inc., the positioning of equipment during fielding activities at NTS, and the procedures used at LLL's facilities in California to reduce and analyze the data recorded on magnetic tape at NTS during an underground nuclear explosion. In summarizing, the authors give the system high marks, attributing its success to good basic design, careful installation, and rigorous calibration and data analysis techniques applied with good judgement on the part of the instrumentation engineers and data analysts. 10 figures.

CIVIL USES

REFER ALSO TO CITATION(S) 42333

WEAPONRY

REFER ALSO TO CITATION(S) 43602

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

43716 **Structure of turbulence over water during high winds.** SethuRaman, S. (Department of Energy and Environment, Brookhaven National Laboratory, Upton, NY 11973). *J. Appl. Meteorol.;* **18**: No. 3, 324-338(Mar 1979).

Turbulence fluctuations over water are found to change for wind speeds more than 10—12 m s^{-1}. Increase in turbulence level beyond this critical wind speed may be attributed to the formation of helical roll vortices. Integral scales of turbulence estimated over water are found to be several times larger than corresponding values over land.

BASIC STUDIES

REFER ALSO TO CITATION(S) 43732, 43742, 43756

43717 (CONF-790445—2) **Identification of unique ecological features in environmental impact assessments.** Reed, R.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, MF A01.

From 19. annual meeting of the institute of environmental sciences; Seattle, WA, USA (29 Apr 1979).

Portions of document are illegible.

The identification of unique ecological features as an example of the problems inherent in making ecological value judgements is discussed. A process for developing a context within which the use of the term unique can be justified is outlined. An analysis of ecological uniqueness is based on a description of the biota and physical environment of a site and a thorough study of the literature on the ecology of the region in which the site occurs. (HLW)

43718 (CONF-7808100—(Summ)) **Forest meteorology: research needs for an energy and resource limited future.** Hutchison, B.A. (ed.). (Department of Energy, Washington, DC (USA). Office of Health and Environmental Research; Ottawa Univ., Ontario (Canada)). Feb 1979. Contract EY-76-C-05-3688. 50p. Dep. NTIS, PC A03/MF A01.

From Forest meteorology-research needs for an energy and resource limited future; Ottawa, Canada (28 Aug 1978).

Discussion is presented on turbulent exchanges within and above forests and radiation energy changes within and above forests. It is concluded that lack of knowledge and understanding of the mechanisms involved in turbulent exchanges of sensible heat, mass, and momentum within forests and across forest-atmosphere inter-

faces is, without doubt, the most critical current problem of forest meteorology. The mechanisms by which turbulence is created, transported, and destroyed in forest canopies must be critically examined. The physical structural characteristics of forest vegetation controlling turbulent exchanges across porous forest canopy surfaces as well as at biomass surfaces must be identified and techniques developed for their quantification. Knowledge of the radiation relationships of forests is further advanced than that of turbulence phenomena. Two major gaps in our knowledge of forest radiation remain, however. First, as with turbulence in forests, the state of our knowledge of the relation between forest structure and radiation microclimate is less than satisfactory. Second, because of the difficulties involved in the measurement of structural characteristics of forests, few, if any, of the models which acceptably simulate and predict radiation in agricultural crops have been tested or validated in forests. The lack of a home for forest meteorology research among the federal agencies of either the United States or Canada has impeded progress in this field. (JGB)

43719 (IDO—12089) **Raptors of the Idaho National Engineering Laboratory Site.** Craig, T.H. (Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Apr 1979. Contract W-7405-ENG-82. 30p. Dep. NTIS, PC A03/MF A01.

From 1974 through 1976 base line data were gathered on the raptors which occur on the Idaho National Engineering Laboratory (INEL) Site. Thirteen species were observed on the INEL Site during the non-breeding seasons. American Rough-legged Hawks, American Kestrels, Golden Eagles, and Prairie Falcons were the most numerous. Marsh Hawks, Ferruginous Hawks, Redtailed Hawks, Swainson's Hawks, Great Horned Owls, Short-eared Owls, Merlins, Cooper's Hawks, the endangered Bald Eagle, and the endangered Peregrine Falcon were all observed on the INEL Site during the nonbreeding seasons although less frequently. American Rough-legged Hawks and American Kestrels were commonly observed in agricultural lands while Prairie Falcons and Golden Eagles were usually seen in areas of native vegetation. Nesting species of raptors on the INEL Site include American Kestrels, and Long-eared Owls. Ferruginous Hawks, Merlins, Prairie Falcons, Redtailed Hawks, Swainson's Hawks, Golden Eagles, Great Horned Owls, and Burrowing Owls also nest on or near the INEL Site. The nesting ecology of American Kestrels, Long-eared Owls, Prairie Falcons, Red-tailed Hawks, Swainson's Hawks, Golden Eagles, and Great Horned Owls on the INEL Site are summarized in this report. The decline of nesting Ferruginous Hawks, Golden Eagles, and Redtailed Hawks on and near the INEL Site is discussed.

43720 (LA—7795-MS) **Experimental design and data of the April 1977 multitracer atmospheric experiment at the Idaho National Engineering Laboratory.** Clements, W.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 101p. Dep. NTIS, PC A06/MF A01.

A multitracer atmospheric transport and diffusion experiment was conducted during April 1977, at the Idaho National Engineering Laboratory. The atmospheric tracers SF_6, C_8F_{16}, C_6F_{12}, C_7F_{14}, $^{13}CD_4$, and $^{12}CD_4$ were released simultaneously in a well-defined and monitored meteorological situation and sampled at various downwind distances. This report describes the details of this experiment, presents a compilation of data collected, discusses the performance of the various tracers and sampling techniques used, and outlines some recent progress and plans.

43721 **Environmental/resource assessment and information.** Washington, DC; National Oceanic and Atmospheric Administration (1979). 7p. (NP—23732).

Six figures are presented to report the April 9—15, 1979 population-weighted heating degree days. These are entitled: Weekly Population - Weighted State Averages of Heating Degree Days, Week Ending April 15, and Departures from Normal; Weekly Population - Weighted Regional and National Heating Degree Days, Week Ending April 15, and Departures from Normal; Seasonal (September 1—April 15), Population - Weighted State Averages of Heating Degree Days, and Departures from Normal; Seasonal (September 1—April 15), Population - Weighted Regional and National Heating Degree Days, and Departures from Normal; Seasonal Population - Weighted States Averages of Heating Degree Days, Ratio of September 1—April 15, to Same Period in 1977/78; and Seasonal Population - Weighted Regional and National Averages of Heating Degree Days Ratio of September 1—April 15 to Same Period in 1977/78.

43722 **Ozone destruction by catalysis: credibility of the threat.** Ellsaesser, H.W. (Univ of Calif, Lawrence Livermore Lab). *Atmos. Environ.:* **12**: No. 9, 1849-1856(1978).

In an effort to assess the credibility of predictions concerning the O$sub 3$ layer and to pinpoint avenues for improving current stratospheric models, a review was undertaken of observational data believed to have a bearing on the validity of destruction of stratospheric O$sub 3$ by catalysis.

43723 **National Climate Program Act. House of Representatives, Ninety-Fifth Congress, Second Session. Conference report [to accompany H.R. 6669].** Washington, DC; House of Representatives (1978). 17p.

The purpose of the National Climate Program Act was to establish a five-year national climate program to be extended biennially that will assist the Nation and the world to understand and respond to natural and man-induced climate processes and their implications. The Program shall include, but not be limited to, the following elements: (1) assessments of the effect of climate on the natural environment, agricultural production, energy supply and demand, land and water resources, transportation, human health and national security; (2) basic and applied research to improve the understanding of climate processes, natural and man induced, and the social, economic, and political implications of climate change; (3) methods for improving climate forecasts on a monthly, seasonal, yearly, and longer basis; (4) global data collection, and monitoring and analysis activities to provide reliable, useful and readily available information on a continuing basis; (5) systems for the management and active dissemination of climatological data, information and assessments, including mechanisms for consultation with current and potential users; (6) measures for increasing international cooperation in climate research, monitoring, analysis and data dissemination; (7) mechanisms for intergovernmental climate-related studies and services including participation by universities, the private sector and others concerned with applied research and advisory services; (8) experimental climate forecast centers, which shall be responsible for making and routinely updating experimental climate forecasts of a monthly, seasonal, annual, and longer nature, based on a variety of experimental techniques; establish procedures to have forecasts reviewed and their accuracy evaluated; and protect against premature reliance on such experimental forecasts.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42191, 42230, 42233, 42236, 42853, 43493, 43498, 43533, 43534, 43581, 43720, 43756, 43758, 43759, 43761, 43766, 43768, 43771, 43844

43724 (ANL/RER—79-1) **Advanced Statistical Trajectory Regional Air Pollution model.** Shannon, J.D. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 38p. Dep. NTIS, PC A03/MF A01.

The Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model is developed and shown to combine efficient calculation of long-term horizontal dispersion with improved parameterizations of boundary-layer processes. The parameterizations include diurnal and seasonal variations of dry deposition velocities for SO_2 and sulfate, the rate of transformation from SO_2 to sulfate, and te vertical structure of the planetary boundary layer. The deposition velocity variations simulate some recent experimental results that indicate that the deposition velocity of sulfate particles is of the same order as that for gaseous SO_2, not an order of magnitude less as usually modeled. The stability variations simulate the cycle of nocturnal inversion formation, intensification and deepening, rise and erosion from below, and dissipation, as frequently observed in field investigations of the planetary boundary layer. An additional improved parameterization is the treatment of wet deposition as a function of the half power of the hourly precipitation, an empirical result. Budget studies in ASTRAP indicate that wet removal is greater than dry deposition within U.S. boundaries for sources within the U.S., particularly during winter, and that the net mass flux across the U.S.-Canadian border resulting from U.S. sources is 3 to 4 times greater than the net mass flux across the border resulting from Canadian sources.

43725 (ANL/RER—79-2) **Guide for estimating dry deposition velocities of sulfur over the eastern United States and surrounding regions.** Sheih, C.M.; Wesely, M.L.; Hicks, B.B. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 62p. Dep. NTIS, PC A04/MF A01.

Atmospheric dry deposition velocities of sulfur dioxide and sulfate particles in the eastern United States and surrounding areas are estimated as functions of location, season, and atmospheric stability. The necessary data sets include a tabulation of the land-use types and a listing of the surface roughnesses and deposition resistances assigned to each land-use type for the conditions likely to be found during spring, summer, autumn, and winter. The estimates of deposition velocity are tabulated and presented as maps, which are particularly useful when only rough estimates of the deposition velocities are required or when meteorological data for estimating atmospheric stability are very limited. If sufficient information is available for evaluating atmospheric stability by use of micrometeorological relations, deposition velocities are more accurately obtained by direct computation, possibly with the help of the

information provided here on land-use types, surface roughnesses, and surface resistances. The land-use map and surface roughnesses can also be applied to other purposes, such as to describe the surface characteristics for a regional-scale dynamic model. For the convenience of the potential users of these data, the results obtained are stored in the data bank maintained at Brookhaven National Laboratory under the U.S. DOE MAP3S program.

43726 (COO—2874-41) **Some problems of validation and testing of numerical air pollution models. Technical report No. 21.** Switzer, P.; Zannetti, P. (Stanford Univ., CA (USA). Dept. of Statistics). Sep 1978. Contract EY-76-S-02-2874. 18p. Dep. NTIS, PC A02/MF A01.

Uses of deterministic and stochastic models in air pollution modeling are reviewed briefly. An analysis of the problem of validation and testing of a general air pollution numerical model is developed, and the different diagnostic checks applied in the literature are discussed in order to identify a good validation procedure in this field. A simple numerical model for the short-term real-time forecasting of CO hourly values in the St. Louis, Missouri area was developed. (JGB)

43727 (COO—4501-1) **Sources of ozone and sulfate in northeastern United States. Annual progress report.** Husain, L.; Dutkiewicz, V.; Coffey, P.E.; Mohnen, V.A. (New York State Dept. of Health, Albany (USA). Div. of Labs. and Research (USA); Health Research, Inc., Albany, NY (USA); New York State Dept. of Environmental Conservation, Albany (USA). Div. of Air Resources; State Univ. of New York, Albany (USA). Atmospheric Sciences Research Center). 15 Nov 1978. Contract EE-77-S-02-4501. 63p. Dep. NTIS, PC A04/MF A01.

Measurements of daily concentrations of ^{7}Be, ^{32}P, and ozone at Whiteface Mountain, New York are reported for June, July, and August of 1977 and 1978. Episodes of high daily ozone are observed to coincide with peak ^{7}Be and ^{32}P concentrations. Since these radionuclides and ozone are produced in the stratosphere, their simultaneous increase is taken to indicate the arrival of stratospheric air. However, ozone is also produced at ground level by photochemical reactions. Therefore, only when the ground level production of ozone is small can a comparison of cosmogenic nuclides and ozone quantitatively yield stratospheric ozone component. On June 15, 1977 at least 80% of the 50 ppBv (daily average) ozone observed originated in the stratosphere. Our data indicate substantial stratospheric contributions on numerous other occasions. The ^{7}Be and ^{32}P concentration measurements can be used to directly determine the accompanying stratospheric ozone if (1) the ^{7}Be (and/or ^{32}P)O_3 mixing ratios in the upper atmosphere, and (2) mean residence time of O_3 are known. Since October 1977, the ^{7}Be concentrations in aerosol samples collected at 10 to 12 km varied from $\leqq$ 0.1 to 5.8 pCi/kg air, whereas ozone concentrations ranged between 27 and 527 ppBv. If the mean residence times and $^{7}Be/O_3$ ratios are known, ground level ^{7}Be concentration will yield the stratosphericozone concentration. We have assumed that ^{7}Be and O_3 have similar residence times. Estimated dialy stratospheric ozone components vary from 10 to 40 ppBv. Measurements of total suspended particulates (TSP), trace elements, and sulfates were also carried out. Since these are produced only at ground level, their daily variations indicate the intensity of pollutant transport from urban/industrial centers to rural Whiteface Mountain. Comparison of the elevated episodic concentrations with surface air mass trajectories show that the polluted air masses originated in the industrial Midwest.

43728 (DOE/FERC—0024) **Steam-electric plant air and water quality control data. Summary report for the year ended December 31, 1975, based on FPC Form No. 67.** (Federal Energy Regulatory Commission, Washington, DC (USA)). Jan 1979. 208p. Dep. NTIS, PC A10/MF A01.

Data relating to nationwide impacts of steam-electric power plants on the environment are discussed with regard to growth of the industry; fuel quality; air pollution control; water pollution control; and cost of cooling facilities. Tables are presented to show the following: air quality data aggregated by state and geographic region and by air quality control region; water quality data aggregated by state and geographic region and by water resource region; and individual plant data. (HLW)

43729 (EPRI-EA—1025) **Indoor—outdoor pollution levels: a bibliography. Interim report.** Morse, S.S.; Moschandreas, D.J. (Geomet, Inc., Gaithersburg, MD (USA)). Mar 1979. 161p. Dep. NTIS, PC A08/MF A01.

This annotated bibliography covers literature on the subject of indoor and outdoor pollution levels. Specifically, the works cited are those which have a bearing on the EPRI-supported study Comparison of Indoor and Outdoor Concentrations of Atmospheric Pollutants. The bibliography is not exhaustive. It contains primarily available publications and research reports which are relevant to the specific objectives of the EPRI—Geomet project: indoor sources of pollutants, behavior of indoor pollutants, indoor—outdoor relationships, and health effects. It does not cover constructions or conservation measures which have an effect on indoor pollutant concentrations. Because the EPRI—Geomet research involves a stuy of air quality in residences and offices, the literature review for this bibliography focused on those two environments. All papers which are listed were obtained and reviewed. Subject and author indices appear at the end of the bibliography for purposes of cross-referencing.

43730 (EPRI-EA—1031(Vol.1)) **Nitrogen oxide interferences in the measurement of atmospheric particulate nitrates. Final report.** Rohlack, L.A.; Hawn, W.C.; Williams, K.R.; Parsons, T.P. (Radian Corp., Austin, TX (USA)). Mar 1979. 72p. Dep. NTIS, PC A04/MF A01.

The results of an experimental program to evaluate the validity of reported atmospheric particulate nitrate concentrations using high-volume (Hi-Vol) sampling techniques are reported. Laboratory and field experiments were conducted to determine the extent of interference that gaseous nitrogen oxides introduce in the atmospheric nitrate determinations. The formation of artifact nitrate was studied as a function of time, filter type, filter pretreatment, particulate type and loading, temperature, humidity, and nitric oxide, nitrous oxide, and ozone concentrations. The highest nitrate values were measured on glass-fiber filters at high nitric oxide and high humidity levels and low temperatures. In fact, the artifact nitrate formed during the collection of ambient samples at these worst-case conditions may be the major contributor to measured particulate nitrate values. The sorption of gaseous nitrogen oxides was reduced from 50 to 100% on teflon, polycarbonate, and acid-washed, glass-fiber filters compared to untreated glass-fiber filters.

43731 (N—79-11560) **Elemental characteristics of aerosols emitted from a coal-fired heating plant.** Singh, J.J.; Khandelwal, G.S. (National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Nov 1978. 21p. NTIS PC A02/MF A01.

Size differentiated aerosols were collected downstream from a heating plant fueled with eastern coal and analyzed using particle induced X-ray emission technique. Based on aerosol masses collected in various size ranges, the aerosol size distribution is determined to be trimodal, with the three peaks centered at 0.54 microns, 4.0 microns, and 11.0 microns, respectively. Of the various trace elements present in the aerosols, sulphur is the only element that shows very strong concentration in the smallest size group. Iron is strongly concentrated in the 4.0 micron group. Potassium, calcium, and titanium also exhibit stronger concentration in the 4.0 micron group than any other group. Other trace elements - vanadium, chromium, manganese, nickel, copper, and barium - are equally divided between the 0.54 microns and the 4.0 microns groups. Apparently, all of the trace elements - except S - enter aerosols during the initial formation and subsequent condensation phases in the combustion process. Excess concentration of sulphur in the 0.54 microns group can only be accounted for by recondensation of sulphur vapors on the combustion aerosols and gas-to-particle phase conversion of sulfate vapors at the stack top.

43732 (ORAU/IEA—79-6(0)) **Uncertainties associated with global effects of atmospheric carbon dioxide.** Rotty, R.M. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Mar 1979. Contract EY-76-C-05-0033. 29p. Dep. NTIS, PC A03/MF A01.

Although the evidence is quite clear that the increase in atmospheric CO_2 is at least to a large degree a result of fossil fuel burning, and it is equally clear that this increase will result in some change in the global climate, there are quantitative uncertainties that require additional understanding before full assessments can be made. There are also quantitative uncertainties regarding the natural carbon cycle, the behavior of the various reservoirs when perturbed by man, the terrestrial biosphere, and the rate at which the oceans can assimilate and store carbon. There are uncertainties in regard to the climate change that can result from increased atmospheric CO_2. Progress in modeling the atmosphere must continue to narrow these uncertainties before the impacts of climate change on man can be adequately determined. The future demands for fossil fuels are uncertain. The growth of the developing world will be closely linked to fossil energy for the next five to eight decades. Only the observed increase in the atmospheric concentration and the present (and recent past) rate of production of CO_2 from fossil fuels provide data without uncertainties.

43733 (PB—286924) **Compilation of level 1 environmental assessment data. Final task report Sep 77-Jun 78.** Gaskins, N.H.; Sexton, F.W. (Research Triangle Inst., Durham, NC (USA)). Oct 1978. Contract EPA-68-02-2156. 504p. NTIS PC A22/MF A01.

The report gives currently available chemical data from 19 Level 1 environmental assessment studies, compiled in standard format. The data are organized within each study by the analytical technique used to generate them. Inorganic data generated by spark

source mass spectroscopy (SSMS), atomic absorption (AA), gas chromatography (GC), chemiluminescence for oxides of nitrogen, anion analysis, and aqueous analysis precede organic data generated by GC for C1-C6/C7 or C7-C17, liquid chromatographic (LC) fractionation, infrared (IR) spectroscopy, and low resolution mass spectroscopy (LRMS). Each study is summarized, followed by the data generated in that study. The studies are organized by industrial type: chemically active fluidized bed combustor, coal-fired boiler, coal-fired power plant, new energy source, coke production, electric arc furnace, fluidized bed combustor, home heater multi-source source, ocean incinerator, oil burner, and textile. The report documents sampling and analytical techniques that were used which are not specified in Level 1. It also includes trends and anomalies that were detected in the 19 studies.

43734 (PB—287206) **Emmission update and projections for Ohio air quality maintenance analysis. Final report.** Corbin, V.; Vincent, L. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Mar 1977. Contract EPA-68-02-1376. 294p. NTIS PC A13/MF A01.

In some areas of Ohio, TSP and SO2 air quality levels are near or above the annual standards. This study was designed to determine the area source emissions for 22 counties, and calculate the contribution of the area sources to the ambient air quality for an areawide receptor grid. To determine if problems will be encountered in maintaining air quality standards in the future, the area source emissions were projected for the years 1980 and 1985. (Portions of this document are not fully legible)

43735 (PB—287493) **Air and water pollution--annual report, FY 74-76. Technical note.** Kirchhoff, W.H.; Myers, E. (National Measurement Lab. (NBS), Washington, DC (USA)). Oct 1978. 390p. NTIS PC A17/MF A01.

The projects covered in this report deal specifically with the following: Air--Research leading to development of SRM's (Standard Reference Materials) or other means for ensuring the accuracy of air measurement methods; Development of laboratory methods with improved accuracy, sensitivity and specificity for air pollution measurements; Generation, evaluation, compilation and dissemination of data and technical information needed to relate the substances emitted from sources of pollution to those found in the atmosphere after chemical reactions have occurred. Water--Evaluation of the accuracy of methods for measuring water velocity and flow in open and closed channels; Development of radioactivity standards; Development of Standard Reference Materials for evaluating the accuracy of instruments and methods for measuring the concentration of pollutants in water and sediments; Measurement evaluation and compilation of physical and chemical properties of known pollutants.

43736 (PB—287499) **Ten NIOSH analytical methods set-5.** (SRI International, Menlo Park, CA (USA)). Jul 1978. Contract DHEW-210-76-0123. 283p. NTIS PC A13/MF A01.

Industrial hygiene sampling and analytical methods were developed and validated under a follow-up research effort to develop measurement methods which failed to validate under the joint NIOSH/OSHA Standards Completion Program. This is the fifth set of 10 methods in an effort to develop methods for 130 substances. Monitoring methods for the following substances are included: S199 Mercury; S321 Nitric Oxide; S319 Nitric Acid; S327 Formaldehyde; S288 Hydrogen Cyanide; S354 Copper (fume); S320 Nitrogen Dioxide; S334 Phosphorus (yellow); S371 Methoxyclor; S374 Methylcyclohexanol.

43737 (PB—287594) **Modeling of visibility reductions and extreme pollutant concentrations associated with southwestern coal-fired powerplants.** Williams, M.D. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Jun 1977. 55p. NTIS PC A04/MF A01.

Two major areas of uncertainty associated with the prediction of impacts of powerplant plumes in the Southwest are visibility effects and high terrain concentrations. This Bulletin reports on studies related to these two questions. It was found that during low-wind-speed stable conditions a very marked visible plume is associated with a large southwestern powerplant. Measurements indicated that fly ash, nitrates, and nitrogen-dioxide were important in the measured opacities which were nearly 100 percent in some cases. In addition, high concentrations of pollutants were found on high terrain. Predictive models are described which permit calculation of visibility effects and high terrain ground level concentration.

43738 (PB—288933) **Shellfish technical assistance. Completion report Jan—Dec 77.** Hickey, J.M. (Massachusetts Dept. of Natural Resources, Boston (USA). Div. of Marine Fisheries). Sep 1978. 139p. NTIS PC A07/MF A01.

The 'Shellfish Technical Assistance' program was implemented January 10, 1973 under Public Law 88-309, and this report includes a detailed account of the last segment (no. 5) from January 1, 1977 to December 31, 1977. The purpose of the program was to assist cities, towns and shellfishermen with the development of shellfish resources. As a result of formal requests, technical assistance was provided by the project on a wide variety of shellfish problems. Major consideration during this segment was given to: oil spill assessment; statewide hydrocarbon analysis; Pacific oyster culture; introduction of the European oyster; administration of Chapter 571; local management programs; management of moderately contaminated areas; quahog culture; and four resource surveys.

43739 (SR—0980-6) **Estimates for wet and dry removals' contribution to the residence time for atmospheric pollutants in the eastern United States.** Vickers, D.; Slinn, W.G.N. (Oregon State Univ., Corvallis (USA). Dept. of Air Resources). Apr 1979. Contract EY-77-S-09-0980. 85p. Dep. NTIS, PC A05/MF A01.

The length of time that atmospheric pollutants released from low-level sources in midwestern United States can expect to remain in the atmosphere is discussed. The pollution is assumed to be removed from the atmosphere by dry deposition and precipitation scavenging. Layer-average trajectories originating from Kansas City, Missouri are used to determine Lagrangian probability of dry and wet conditions. The residence time of these pollutants is estimated based on parameterizations for the effective scavenging rates during wet and dry conditions. This investigation shows that, in summer, probability that precipitation is being experienced by the pollutant is twice as great as the probability of precipitation at the origin of pollution; this same ratio of probabilities is three in winter. Therefore, when precipitation scavenging is the more important removal mechanism, statistics for length of wet and dry periods at the source region overestimate residence time by a factor of about two to three. By taking into consideration Lagrangian probability of wet and dry periods, the relative importance of dry deposition and precipitation scavenging is discussed as a function of the wet and dry removal rates. It is seen that for a time- and vertical-average dry deposition velocity as large as 1 cm/sec, then dry deposition would normally be the more important removal process for the meteorological conditions in the midwest to eastern United States. Estimates for the expected atmospheric lifetimes of aerosol particles and trace gases are reported as functions of dry deposition velocities and collection efficiencies (or washout ratios). For example, lead particles of mass mean diameter ~ 0.5 μm, should have a residence time ~ 8 days in winter, and ~ 3 days in summer, based on available data for the dry deposition velocity and washout ratio. In general, the residence time can be expected to be about twice as long during the summer season than the winter.

43740 (UCID—18159(Rev.1)) **Treatment of initial and boundary conditions in the application of air quality models.** Duewer, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

Initial and boundary concentrations can have an influence on model computed results for suburban and downwind areas that approaches the importance of emissions, and can have a significant influence on calculations of secondary pollutants even in central urban areas. Moreover, this is true even when the initial and boundary concentrations are of the order of a few to one hundred ppB. (On the other hand boundary and initial concentrations will rarely if ever cause or make a major contribution to violations of standards for primary pollutants. The problem with respect to concentrations approaching the standards is largely limited to secondary pollutants). Although most current model applications use lower background values than were used even two or three years ago, currently used concentrations are not low enough to be a negligible factor in model calculations. Moreover, except for carbon monoxide, there is little reason to believe that even the lower concentrations used in model applications are as low as those representative of a remote tropospheric air mass. Conversely, there is also little reason to believe that the air 10 to 100 km from a representative urban center should be very close to remote tropospheric air in its composition. Thus, the specification of initial and boundary conditions remains a major problem in the verification and application of air quality models. The problem ofchoosing initial and boundary conditions should be considered when the choices of model domain and meteorological conditions are made. If a city is at the western edge of a populous region, it is likely that boundary concentrations will be lower and more easily estimated so that calculations will be more reliable if the winds are from the west. If a city is embedded in a megalopolis, a large scale model is likely to be required at least for species like ozone that require several hours for their formation from their precursors.

43741 (UCRL—50042-78) **Annual report of Lawrence Livermore Laboratory to the FAA on the High Altitude Pollution Program, 1978.** Luther, F.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1978. Contract W-7405-ENG-48. 54p. Dep. NTIS, PC A04/MF A01.

Studies on model simulation of observed stratospheric variations were conducted with regard to: the natural stratosphere;

possible variations in stratospheric ozone related to the 11-yr solar cycle; and effects of a solar eclipse on stratospheric chemistry. Assessment studies were conducted on changes in ozone due to SST emissions, chlorofluoromethanes, and $N_2$0; potential effects of space shuttle emissions; potential effects of solar power satellite launch vehicles; effects of a massive pulse injection of NO/sub x/ into the stratosphere; effects of stratospheric perturbations on the earth's radiation budget and the climatic implications; and effect of ozone reductions on erythema dose. (HLW)

43742 (UCRL—82540) **Zonal model calculation of the climatic effect of increased CO_2.** Potter, G.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 24p. (CONF-790458—1). Dep. NTIS, PC A02/MF A01.

From Symposium on environmental and climatic impact of coal utilization; Williamsburg, VA, USA (17 Apr 1979).

This study was a preliminary numerical experiment to test the effect of changing atmospheric CO_2 concentrations on the climate simulated by a zonal atmospheric model including numerous feedback mechanisms. The main results of this analysis may be summarized as follows: (1) increased CO_2 concentrations warm the troposphere and reduce the intensity of the polar surface inversions. This effect caused the magnification of the temperature response with latitude; (In the case of the zonal model, polar temperatures were very cold, and te warming associated with the increased CO_2 and water vapor only partially compensated for the intense sub-freezing temperatures. Consequently, no snow or ice melted even though the surface temperatures increased); (2) The magnitude of the stratospheric temperature difference increased with altitude as CO_2 concentrations were increased; (3) Precipitation, evaporation, and the total atmospheric water content increased with increasing CO_2 concentrations, (The Bowen ratio (H/LE) decreased with increasing CO_2).

43743 (UCRL—82576) **Trends in other species.** Penner, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

Predicted and measured trends in trace species other than ozone are compared and current knowledge regarding man's role in the budget for several species is discussed. Possible trends in stratospheric species caused by long-term solar uv variability are compared to trends detected to date or to predicted trends caused by anthropogenic emissions. Halocarbons, CO, and CO_2 are considered first. Then current thinking is reviewed on possible trends in N_2O, CH_4, and H_2O whose concentrations may have increased in the past. Finally, the trends expected for species (other than ozone) from solar flux variations are discussed. The predicted changes from uv flux variations appear to dominate the other trends discussed herein at high altitude.

43744 Precipitation scavenging of urban pollutants by convective storm systems. Hales, J.M.; Dana, M.T. (Battelle-Northwest Laboratories, Richland, WA 99352). *J. Appl. Meteorol.;* **18**: No. 3, 294-315(Mar 1979).

During the summer periods of 1972 and 1973 a precipitation chemistry network for the analysis of rainborne urban pollutants was operated in a region surrounding the St. Louis metropolitan area. The purposes of this network were to assess the effectiveness of convective storms in removing urban pollutants and to provide a data base for scavenging model development.Designed on the basis of a material balance of pollutant over the city, this network concentrated on elucidation of the scavenging behavior of the inorganic, nonmetallic species NH^+_4, NO^-_3, NO^-_2, SO_2, SO@sup 4, and H^+. Quantities of rainborne material deposited on the network downwind of the city, comparable to the urban pollution burden, indicated precipitation scavenging to be a highly efficient removal mechanism. Much of the observed rainborne sulfate and nitrate appears to have been incorporated into the rain by scavenging of gaseous precursors. This finding implies strongly that a rapid oxidation of SO_2 to sulfate occurs in cloud systems in warm, polluted environments and leads to a possible explanation for observed seasonal trends in sulfate levels.

43745 ECO Watch: environmental protection at ORNL. Oakes, T.; Shank, K. *Oak Ridge Natl. Lab. Rev.;* **12**: No. 1, 1-9(Win 1979).

Responsibilities of the Environmental Surveillance and Evaluation Section (ESES) and Environmental Coordinator's Office (ECO) of Oak Ridge National Laboratory (ORNL) are discussed. These include monitoring for radioactive and other pollutants in the atmosphere, water, foodstuffs, biological specimens, terrestrial environment, and other media of interest. A network of air and water monitoring stations is maintained at distances up to 75 miles from ORNL. Milk is the principal foodstuff analyzed, although various species of fish and other aquatic life are also collected and analyzed routinely for radioactivity and occasionally for nonnuclear contaminants. Other responsibilities include the monitoring of laboratory activities to assure compliance with federal environmental regulations. (JGB)

43746 Metals from flyash. Canon, R.M. *Oak Ridge Natl. Lab. Rev.;* **12**: No. 1, 18-22(Win 1979).

Research underway to develop processes capable of recovering significant amounts of valuable materials from coal residues, principally fly ash, is reviewed. A second goal of the program is to produce a solid material that can be sold or disposed of at lower cost than can the untreated coal residue. Emphasis is placed on the Calsinter process, in which a sulfuric acid leach removes about 98% of the Al present and more than 90% of many other metals. The solids volume is reduced by about 60%. (JGB)

43747 Development of a rational system of trapping sulfur oxides from the stack gases of boiler units. Krylenko, V.I.; Ageeva, T.A. *Prom. Energ.;* No. 12, 35-58(Dec 1978). (In Russian).

A description is given of a lime-alkaline method of removing sulfur oxides from escaping gases from power plant boilers. This method's advantages are the simultaneous trapping of sulfur oxides and solid particles in the same equipment. A technological diagram for complex purification is presented. 7 references.

43748 In-situ mass spectrometry at stratospheric altitudes. Woods, R.O. (Sandia Labs, Albuquerque, NM). *Atmos. Technol.;* No. 9, 20-26(Spr 1978).

The flight system described here grew out of an instrument originally developed for application on sounding rockets. Because of the environment for which it was designed, the analyzer itself was immediately adaptable to balloon experiments, being rugged and lightweight. It was necessary, however, to add a pumping system in order to allow the instrument to operate at the lower altitudes and higher densities of a balloon experiment. A zeolite cryopump was selected. Discussion is presented on the electronics package, circuitry, sample induction, flight experience, and data reduction. (JGB)

43749 Measurements of minor constituents in the stratosphere by chemiluminescence. Ridley, B.A. (York Univ, Toronto, Ontario). *Atmos. Technol.;* No. 9, 27-34(Spr 1978).

In-situ methods that can be used in the stratosphere and based on chemiluminescent reactions of NO/sub x/ and oxides of hydrogen (HO/sub x) with ozone (O_3) are received. Mechanisms of the reactions are discussed. Diagrams of the NO—O_3 instrument and means of operation are given. (JGB)

43750 Survey on air pollution and deterioration of stonework in Venice. Fassina, V. (Restor Lab of St. Gregory, Venice, Italy). *Atmos. Environ.;* **12**: No. 11, 2205-2211(1978).

The study of effects of environmental conditions on the deterioration of stonework in Venice, Italy was carried out. Daily measurements of the concentrations of some atmospheric pollutants were determined. Aerosol acidity, sulfate particulate matter, and sulfur dioxide concentrations showed a seasonal trend. Microscopic and microchemical examination showed that in surface cracks caused by the formation of calcium sulfate, a wetting phase with a deep penetration of solutions containing sulfuric acid and sodium chloride takes place. The crystallization of soluble salts, in the drying phase, causes mechanical stresses which break the stone.

43751 Toxicology of fossil fuel processes. Coffin, D.L. (Environmental Protection Agency, Research Triangle Park, NC). pp 157-167 of Speciality conference on: toxic substances in the air environment. Pittsburgh, PA; Air Pollution Control Association (1977).

From APCA specialty conference on toxic substances in the air environment; Cambridge, MA, USA (7 Nov 1976).

Efforts in the energy development field are designed to obtain information on the health and environmental impact of the emerging energy sources as quickly as possible, so that no delay occurs in providing health data for these technologies, so that they may proceed and develop as quickly as possible to meet the nation's needs. The program is broadly comprehensive and is being conducted on an interagency level. It embodies toxicology, but where possible, health risks of existing populations are being explored as well. The overall purpose is to insure that these industries develop quickly as technically feasible with the assurance that no harmful effects on environment or human health will occur. Four areas are being investigated intensively by the concerned federal agencies: hazards associated with mining, handling, and processing of coal; hazards associated with increased direct combustion of coal; hazards associated with conversion of coal and combustion of the converted products; and hazards associated with mining of oil shale and extraction, refining, and combustion of shale oil products.

43752 N-nitrosamines in the air environment. Fine, D.H.; Morrison, J.; Rounbehler, D.P.; Silvergleid, A.; Song, L. (Thermo Electron Cancer Research Center, Waltham, MA). pp 168-181 of Specialty conference on: toxic substances in the air environment. Pittsburgh, PA; Air Pollution Control Association (1977).

From APCA specialty conference on toxic substances in the air environment; Cambridge, MA, USA (7 Nov 1976).

Although human exposure to N-nitrosamines has classically been associated with nitrite preserved foodstuffs such as cooked bacon, recent data have indicated that N-nitrosamines are ubiquitous in the environment, being present as major contaminants in cutting fluids and in certain widely used herbicides. N-nitrosodimethylamines (NDMA), the n-nitrosamine usually found in foodstuffs, has recently been reported to be present in industrial waste water, in salt water tidal basins, in soil, and as an air pollutant in Baltimore, Maryland and Belle, West Virginia. Recent measurements of N-nitrosamines in Belle, in upstate New Jersey, in New York City, and in Boston are reported. NDMA was not found to be present in New Jersey, in New York City or in Boston. In Belle, as in Baltimore, the source of the NDMA was traced to a chemical factory where NDMA was either being used as an intermediate, or was formed as a by-product during the manufacture of related compounds.

43753 Measuring techniques of nitrogen oxides in automobile exhaust gases. Aoyama, H. *Sangyo Kogai Boshi Gijutsu;* **1974**: 74-82(Jun 1974). (In Japanese).

Important analyzers for nitrogen oxides are the nondispersive infrared analyzer (NDIR), the nondispersive ultraviolet analyzer (GDUV), and the chemiluminescence NO/NO/sub x/ analyzer (GLD). The NDIR is very rapid in response with wide measurement range. Therefore, it is suited for the continuous determination of NO/sub x/ in automobile exhaust gases. The GDUV makes use of the strong absorption of ultraviolet rays of 320 to 500 millimicron by nitrogen-dioxide. The absorption is not interfered with by the presence of moisture. It is usual practice to determine nitric oxide with NDIR and NO_2 with the NDUV and the sum of the data is taken as the content of NO/sub x/. The GLD was developed to eliminate the faults that accompany the NDIR and NDUV. Problems that remain to be solved are the method of sampling, the elimination of the effects of the atmosphere, and the method of calibration of the analyzers. For example, NO/sub x/ discharged from the automobiles is present as NO in the neighborhood of the exhaust tubes. However, NO changes into NO_2 with time and forms N. This NO_2 is so active that it reacts with the parts of the measuring instruments or with other substances causing an error in the determination.

43754 Waste gas emissions in the vicinity of coking plants. Measurement of gaseous and odorous pollutants. Hermann, P. *Schriftenr.: Lagerstaettenerfassung Darst., Bodenbewegungen Bergschaeden;* No. 5, 121-136(1973). (In German).

In the vicinity of 35 coking plants in North Rhine-Westphalia the concentrations of ammonia, phenol, hydrogen sulfide and the total amount of organic compounds were measured and the odor intensity determined by using as a criterion the degree of reduction of odor intensity with distance. Most measuring points were between 150 and 450 m from the coking plant center. For the analytical determination of HS the molybdenum blue method was used. Phenol was photometrically determined after a reaction with p-nitraniline. The organic compounds were analyzed with a flame ionization detector. In a radius of less than 500 m of all 35 coking plants the odor threshold for HS was exceeded during at least one measurement day while that of NH_3 was exceeded at 24 plants. Five plants had no intense odors and values above 0.15 mg H_2S/cu m or 0.04 mg NH_3/cu m were not measured. No correlation between the odor sensation and the emmission concentration for HS as well as the odor threshold for ammonia was found. All ammonia concentrations were less than one twentieth of the maximum allowable working place concentrations. About 60% of all measured NH_3 and HS concentrations were above the odor threshold. The odor threshold of phenol was not reached.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42428, 43720, 43735, 43773, 43836, 43837, 43838

43755 (CONF-790101—3) **Validation of Turner Workbook normalized air exposure predictions for surface level releases using Hanford dispersion data.** Miller, C.W.; Little, C.A.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From 4. symposium on turbulence, diffusion and air pollution; Reno, NV, USA (15 Jan 1979).

In general, the methods used to determine atmospheric stability in assessment models depend upon the personal needs of the assessor. However, the results of this study indicate that for conditions similar to those prevailing during the Hanford tests and for the assumptions used with the Turner Workbook calculations, a method of atmospheric stability determination based on the vertical temperature gradient should be used if the assessor desires to insure some conservatism in his calculations of Eu/Q. On the other hand, a more realistic estimate of Eu/Q can be obtained using a method based on σ/sub θ/, recognizing that a tendency still exists to overpredict Eu/Q. An additional approach to improve model predictions would be to apply the linear regression parameters shown in Table 4 to predictions based on the vertical temperature gradient methods. Application of the regression parameters to adjust the predictions is feasible because of the relatively high correlation between measured and predicted value exhibited by all three methods of stability determination.

43756 (DP—1486) **Measured weekly ^{85}Kr concentrations with 150 km of the Savannah River Plant (March 1975—August 1976).** Pendergast, M.M.; Boni, A.L.; Ferber, G.J.; Telegadas, K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1979. Contract EY-76-C-09-0001. 58p. Dep. NTIS, PC A04/MF A01.

This report includes a body of ^{85}Kr release data and associated meteorological data with which to evaluate methods of calculating the transport and dispersion of gaseous effluents at distances of 25 to 150 km. A sampling network of 13 stations surrounding the Savannah River Plant operated continuously, taking one-week averaged samples between March 1975 and September 1977. The ^{85}Kr release data, site meteorological data, and observed weekly ^{85}Kr concentrations in air samples are tabulated for the first 18 months of the sampling period.

43757 (DP-MS—78-87) **Stack released plutonium in the environment of a nuclear fuel reprocessing facility.** Horton, J.H.; Sanders, S.M.; Corey, J.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 16p. (CONF-790634—1). Dep. NTIS, PC A02/MF A01.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

Chemical separations facilities at the Savannah River Plant have released very small quantities of plutonium to the environment since 1955. Characterization studies of airborne particulates from the process stack show that the plutonium is nearly always attached to nonradioactive particles. The geometric mean diameter of plutonium-bearing particulates in the stack gas is 5.43 μm. Most of the particles contain less than 10^{-15} Ci of ^{239}Pu. Studies with cascade impactors 1.1 m above the ground indicated that the average annual air concentration was 612 x 10^{-18} Ci/m^3 (less than 0.1% of the maximum permissible concentration recommended by the ICRP). Cropping studies showed plutonium concentrations of 3 x 10^{-3} pCi/g in wheat, 5.5 x 10^{-4} in soybeans, and 1.7 x 10^{-4} in corn. The 70-year dose-to-bone from ingesting 10^5 g of grain would be less than 1 mrem.

43758 (GEPP-EM—427) **Environmental monitoring report, 1978: Pinellas Plant.** (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). Apr 1979. Contract EY-76-C-04-0053. 35p. Dep. NTIS, PC A03/MF A01.

Effluent and environmental monitoring programs maintained by the Pinellas Plant are designed to determine efficiencies of treatment and control mechanisms; to provide measurements of discharge concentrations for comparison with applicable standards; and to assess the concentrations of these discharges in the environment. Small quantities of tritium gas, tritium oxide and krypton-85 gas were released from the plant during the year. Average maximum ground level concentrations of these radioisotopes were all significantly less than 1/10 of 1 percent of the recommended guide for continuous nonoccupational exposure. Off-site releases of liquid effluents were analyzed for compliance with NPDES permit issues for this site by the U.S. Environmental protection Agency. Analyses were performed fo biochemical oxygen demand, suspended solids, fecal coliform bacteria, pH, nitrogen, phosphorus, arsenic, chlorides, chromium, copper, cyanides, detergents, fluorides, iron, lead, mercury, oil plus greases, phenols, turbidity and zinc. All results with the exception of suspended solids were well within permit limits. Site perimeter and off-site air samples for tritium gas and tritium oxide, as well as off-site surface water samples obtained to distances of 9.6 kilometers (6 miles) from the plant site and analyzed for tritium content, showed levels significantly less than 1/10 of 1 percent of the recommended guide for continuous nonoccupational exposure. Calculations were made to determine the radiation doses resulting from releases of tritium oxide and krypton-85 to: an individual at the site boundary; individuals in the closest residential area; and the population within 80 kilometers (50 miles) of the plant site. Calculated doses are exceedingly small when compared to the recommended standards. The total dose commitment to the population residing within 80 kilometers (50 miles) was determined to be 0.40 man-rem as compared to annual dose from natural radiation of 210,747 man-rem.

43759 (KAPL—4117) **Knolls Atomic Power Laboratory annual environmental monitoring report. Calender year 1978.** (Knolls Atomic Power Lab., Schenectady, NY (USA)). Mar 1979. Contract EY-76-C-12-0052. 49p. Dep. NTIS, PC A03/MF A01.

The effluent and environmental monitoring data summarized in this report show that 1978 operations at the three KAPL sites did not result in significant releases to nor impacts on the environment or the general public. None of the measurements for radioactivity in environmental media indicated any activity attributable to 1978 operations at any of the three KAPL sites. The annual average radioactivity concentrations in liquid and gaseous effluents from each site correspond to less than 0.1 percent of the effective radioactivity concentration guides at the site boundaries. The maximum potential exposures to individuals in off-site areas and the average exposure to members of the nearest population group were less than 0.1 percent of that permitted by the federal radiation protection standards. In addition, the maximum potential exposure to individuals in off-site areas was less than one percent of that permitted by the numerical guide for whole body exposure. The estimated exposure from KAPL operations to the population within 80 kilometers (50 miles) of any site was less than 0.2 man-rem, which corresponds to less than 0.0001 percent of the dose received by the population from natural background radiation. The chemical constituents in the liquid effluents from KAPL operations resulted in no measurable effect upon the quality of the receiving water. The average concentrations of chemical constituents and particulates in exhaust air conformed to state standards.

43760 (LA—7480-MS) **Sorption—desorption studies on tuff. I. Initial studies with samples from the J-13 drill site, Jackass Flats, Nevada.** Wolfsberg, K.; Bayhurst, B.P.; Crowe, B.M.; Daniels, W.R.; Erdal, B.R.; Lawrence, F.O.; Norris, A.E.; Smyth, J.R. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 60p. Dep. NTIS, PC A04/MF A01.

Distribution coefficients were determined for sorption—desorption of radionuclides between each of three different types of tuff from drill hole J-13 at the Nevada Test Site and water from that well. The measurements were performed under atmospheric conditions at 22°C and 70°C. Sorption ratios vary greatly with lithologic variety of tuff. A tuff high in zeolite minerals has high sorption ratios (in decreasing order) for Eu, Ba, Cs, and Am and intermediate ratios for Sr and Pu. A tuff high in glass shows very high ratios for Ba, Sr, and Cs, intermediate values for Am and Pu, and low values for Ce and Eu. A devitrified tuff similar mineralogically to a microgranite exhibits intermediate values for Ba, Cs, Am, and Pu and low values for Eu, Ce, and Sr. Values for Ru are low, and those for Mo, Sb, and I are very low or zero for the three types. 34 figures, 32 tables.

43761 (MHSMP—79-24) **Environmental monitoring report for Pantex Plant covering 1978.** Alexander, R.E.; Cornelius, V.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). May 1979. Contract EY-76-C-04-0487. 53p. Dep. NTIS, PC A04/MF A01.

This report summarizes the environmental monitoring program at Pantex Plant for 1978. It has been prepared in accordance with the United States Department of Energy Manual Chapter 0513. This report presents monitoring data for both radioactive and nonradioactive species in the local environment. Although plant activities involve the handling of significant quantities of uranium, plutonium, and tritium, only small releases of uranium (depleted in the isotope ^{235}U) and tritium occurred which could have affected the local environment. Monitoring data indicate that concentrations of these nuclides in the environment are below established criteria for air and water and therefore should not present a health hazard either to employees or to the public.

43762 (NUREG—0556) **Final environmental statement related to operation of White Mesa Uranium Project, Energy Fuels Nuclear, Inc.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). May 1979. 274p. NTIS, PC A13/MF A01.

Environmental impact statements are presented under the following headings: the existing environment; mining and milling operations; air quality; land use; mineral resources; soils; radiological impacts; socioeconomic impacts; environmental effects of accidents; monitoring programs; unavoidable adverse environmental impacts; relation between short-term uses of the environment and long-term productivity; irreversible and irretrievable commitments.

43763 (NUREG/CR—0523) **MESODIF-II: a variable trajectory plume segment model to assess ground-level air concentrations and deposition of effluent releases from nuclear power facilities.** Powell, D.C.; Wegley, H.L.; Fox, T.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1978. Contract EY-76-C-06-1830. 319p. (PNL—2419). Dep. NTIS, PC A14/MF A01.

MESODIF-II is a variable trajectory plume segment atmospheric transport model designed to predict normalized air concentrations and deposition of radioactive, but otherwise non-reactive, effluents released from one or two levels over the same position in an xy-plane. In such a model, calculated particle trajectories vary as synoptic scale wind varies. At all sampling times the particles are connected to form a segmented plume centerline; the lateral and vertical dimensions of the plume are determined by a parameterization of turbulence scale diffusion. The model development arose from the need to assess the radiological effects of routine operations of commercial nuclear power reactors. The purpose of the present document is to make MESODIF-II and its peripheral programs available to those who wish to use it directly. The theory and mathematics in the model are explained. A user's guide, which treats not only MESODIF-II descriptively, but also other programs that have to be used to generate the input wind and stability data is included. Two other peripheral programs that are used in conjunction with MESODIF-II are also described. One is Program Stagg, the other is Program RERITE. A complete test run of MESODIF-II is included, as is the complete code for the program and the control cards used on the CDC-6400. A glossary for the MESODIF-II code, and a reference list arealso provided.

43764 (ORNL—5532) **AIRDOS-EPA: A computerized methodology for estimating environmental concentrations and dose to man from airborne releases of radionuclides.** Moore, R.E.; Baes, C.F. III; McDowell-Boyer, L.M.; Watson, A.P.; Hoffman, F.O.; Pleasant, J.C.; Miller, C.W. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 270p. Dep. NTIS, PC A12/MF A01.

The AIRDOS-EPA computer code is a methodology, designed for use on IBM-360 computers, that estimates radionuclide concentrations, in air; rates of deposition on ground surfaces; ground surface concentrations; intake rates via inhalation of air and ingestion of meat, milk, and fresh vegetables; and radiation doses to man from airborne releases of radionuclides. This report describes the atmospheric and terrestrial transport models used in the code, their computer implementation, and the applicability of the code to the assessment of radiological impacts. A listing of the code and a demonstration run of the code are presented in the appendices. A modified Gaussian plume equation is used to estimate both horizontal and vertical dispersion of as many as 36 radionuclides released from one to six stacks or area sources. Radionuclide concentrations in meat, milk, and fresh produce consumed by man are estimated by coupling the output of the atmospheric transport models with the U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109 terrestrial food chain models. Dose conversion factors are input to the code, and doses to man at each distance and direction specified are estimated for total body, red marrow, lungs, endosteal cells, stomach wall, lower large intestine wall, thyroid, liver, kidneys, testes, and ovaries through the following modes: immersion in air containing radionuclides, exposure to ground surfaces contaminated by deposited radionuclides, immersion in contaminated water, inhalation of radionuclides in air, and ingestion of food produced in the area.

43765 **Instrumentation for monitoring plutonium in the environment.** Nero, A.V. Jr. (California Univ., Berkeley). *Nucl. Saf.;* **20**: No. 3, 280-291(May 1979).

Substantial amounts of plutonium are produced in both civilian and military nuclear programs, and permissible environmental plutonium concentrations are very low. This article describes instrumentation for monitoring plutonium in the environment, with emphasis on alpha monitoring techniques used for direct air monitoring or following radiochemical analysis and gamma/x-ray monitoring techniques for surveying possible contamination of areas or humans.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

43766 (ANL-Trans—1163) **Programs F0G1PLT and F0G2PLT for plotting cooling tower plumes calculated by the F0G1 program.** Rudin, F. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1979. Translation of pp 1-14 and 25, TM-ST—564. 29p. Dep. NTIS, PC A03/MF A01.

F0G1PLT is an expansion of the F0G1 program and serves for plotting a vertical longitudinal section of the moisture field of the calculated cooling tower plume. Selected isolines of the moisture elevation are plotted and condensation zones are identified by dot-shading. F0G2PLT is also an expansion of F0G1 and allows a superposition of the plumes of up to five cooling towers located at great distances from each other (1 to several km) and to present the results graphically in the same way as with F0G1PLT. Up until now, cases with up to four cooling towers were computed with spacings of 2 to 30 km between two conseecutive towers and a total distance of 60 km for plume diffusion. The results obtained under these conditions were physically plausible.

43767 **Potential weather modification caused by waste heat release from large dry cooling towers.** Lee, J. (Assistant Environmental Scientist, Energy and Environmental Systems Division, Argonne

National Laboratory, Argonne, Ill. 60439). *J. Heat Transfer;* **101**: No. 1, 164-168(Feb 1979).

A numerical model of a cooling tower plume is employed to study the possible atmospheric effects of thermal plumes from natural draft dry cooling towers. Calculations are performed for both single and multiple towers, each of which can dissipate the waste heat from a nominal 1000 MWe power generating unit, and the results are compared with those for wet cooling towers associated with plants of the same generating capacity. Dry cooling tower plumes are found to have a higher potential for inducing convective clouds than wet cooling tower plumes, under most summertime meteorological conditions. This is due to the fact that both the sensible heat and momentum fluxes from a dry tower in summer are approximately one order of magnitude larger than those from a wet cooling tower.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 43719, 43720

REGULATIONS

43768 Speciality conference on: toxic substances in the air environment. Pittsburgh, PA; Air Pollution Control Association (1977). 108p. (CONF-7611105—).

From APCA specialty conference on toxic substances in the air environment; Cambridge, MA, USA (7 Nov 1976).

Papers presented are divided into the following categories: toxic substances legislation; arsenic; vinyl chloride; and emerging problems in toxic emission. Seven papers were abstracted and indexed individually for ERA/EDB. (JGB)

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 43717, 43718

43769 (COO—3531-36) **Technical progress report of biological research on the Volcanic Island Surtsey and its environs for the period 1965—1978.** Fridriksson, S. (Surtsey Research Society, Reykjavik (Iceland)). 1978. Contract EY-76-C-02-3531. 116p. Dep. NTIS, PC A06/MF A01.

Progress is reported on the following research projects: changes in shoreline and surface of the island due to volcanic activity; colonization of microorganisms, algae, lichens, and vascular plants; introduction of insects and other arthropods by wind, water, and man; transport of invertebrates to the island by flotsam of the sea; species and nesting habits of birds on the island; behavior of seals on beaches of the island; and future trends of Surtsey ecosystems. (HLW)

43770 (EGG—1183-2356(Add.)) **Addendum to status of endangered and threatened plant species on Nevada Test Site: a survey, Parts 1 and 2.** Rhoads, W.A.; Cochrane, S.; Williams, M. (EG and G, Inc., Goleta (USA). Energy Measurements Group). Jan 1979. Contract EY-76-C-08-1183. 29p. Dep. NTIS, PC A03/MF A01.

This addendum revises and updates the report, Status of Endangered and Threatened Plant Species on Nevada Test Site - A Survey, Part 1: Endangered Species, and provides information and opinions on status about one species from Part 2: Threatened Species of that report (No. EGG 1183-2356). Since completion of Part 2 in June 1978, new information and field data concerning the endangered and threatened species have been collected. The format for presentation of this information is essentially the same as that used in Part 2. However, the headings in this addendum, Distribution, Habitat, etc., are only included when new information is presented. If a heading is absent under a particular species, then the material furnished in Parts 1 and 2 remains our opinions or knowledge of the species. A new heading, Listings, has been created to allow summarization of past and present opinions on status held by different groups and agencies concerning each species. Also, new REVD-T ratings have been assigned to the candidate endangered species treated in Part 1, based on the definitions of REVD-T terms used in Part 2. This facilitates comparison of the status of species treated in Part 1 with those covered in Part 2. A compilation of species treated in both Part 1 and 2, their recommended status, and our present REVD-T ratings follow the discussions of individual species.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 43338, 43745, 43751, 43845

43771 (ORNL/TM—6799) **Need for regional ecology. Environmental Sciences Division publication No. 1318.** Klopatek, J.M.; Shugart, H.H. Jr.; Harris, W.F.; Brocksen, R.W. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

Concepts pertaining to regional ecology and five attributes of regional ecological systems which distinguish them from ecosystems are discussed. The attributes include the points that make up regional ecological systems and which must be studied as open systems, with man included, as well as nonecological flows. Two examples, acid precipitation and land use, are cited as ecological problems which dictate the need for a regional ecological approach for their solution. Quantified methodologies that can be used in regional ecology are discussed. The methodologies fall under one of two headings - regional indexing or regional modeling. The need for an interdisciplinary approach to regional ecological problems is also discussed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42431, 43762, 43786, 43837

43772 (PB—288743) **Radioactivity in consumer products.** Moghissi, A.A.; Paras, P.; Carter, M.W.; Barker, R.F. (Georgia Inst. of Tech., Atlanta (USA). Office of Interdisciplinary Programs). Aug 1978. 509p. NTIS PC A22/MF A01.

This book is based on papers presented at the symposium. Topics covered include: Regulations and standards; general and biological risks; radioluminous materials; mining, agricultural, and construction materials containing radioactivity; products cotaining radioactive sources; miscellaneous products.

43773 (SR—0980-5) **Experimental studies of resuspension and weathering of deposited aerosol particles.** Reynolds, B.W.; Slinn, W.G.N. (Oregon State Univ., Corvallis (USA)). Apr 1979. Contract EY-77-S-09-0980. 112p. Dep. NTIS, PC A06/MF A01.

Estimates of the magnitude of wind-caused particle entrainment to the atmosphere from natural surfaces are needed as inputs to impact assessments for the nuclear industry. An experiment using a supermicron inert tracer and a portable wind stress generator was designed to measure the resuspension rate and the weathering rate. The method used was to deposit a known surface concentration and sample air mass loadings for a variety of natural surfaces. Samples from each surface were matched for similar characteristics of wind stress, surface moisture, time since deposition of the tracer, and degree of weathering. The results show average resuspension rates, Λ, to be 1.3×10^{-6}, 2.3×10^{-6}, and 5.6×10^{-6} sec^{-1} for mown grass, silt loam soil, and gravel, respectively. A dependence of Λ's on the friction velocity, was suggested for the samples with the least surface moisture conditions. A dependence of Λ on the surface roughness height was also found. Λ was found to decrease with sampling time for soil and mown grass, suggesting a depletion of readily available tracer under moist and semi-moist conditions. Gravel's Λ's for the moist case increased with incresing time. Surfaces were exposed to two to three precipitation and wind events, and th results were compared qualitatively. With much variation, gravel, followed by mown grass and then soil were affected most to least, respectively, by the prescribed weathering events. In general, Λ's did not decrease with increasing time for the 174 days of the study. This would seem to suggest that no time-dependent weathering occurred in this study.The data base for resuspension and weathering parameters should continue to be expanded by employing submicron tracers, better surface tracer concentration and moisture measurements, larger wind stress generators, and measures of atmospheric stability's effects. (ERB)

SOIL

REFER ALSO TO CITATION(S) 42417, 42426, 42437

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 43745, 43757, 43761, 43765

43774 (AECL—6306) **TERMOD II: an interactive code for analyzing intake of radionuclides by man through terrestrial pathways.** Zach, R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Nov 1978. 39p. Dep. NTIS (US Sales Only), PC A03/MF A01.

An interactive code, TERMOD II, has been written in FORTRAN IV for the PDP 10. This code allows calcuation of the time-dependent input of radionuclides through terrestrial pathways to man following an acute or accidental release. TERMOD II calculates daily input rates of radioactivity and the total intake rate over specified periods. To calculate these rates, TERMOD II uses the TERMOD model developed at Oak Ridge National Laboratory. This model includes three food types which can be contaminated by fallout radionuclides. Food crops and grass can be contaminated by direct foliar deposition and by root uptake. Milk and beef can be contaminated via ingestion of contaminated grass. The user of TERMOD II can choose from 78 different radionuclides. Additional radionuclides can be added as more data become available. Summaries of intake rates can be displayed at a local terminal or at an auxiliary high-speed printer.

43775 (UCRL—81640) **Transfer coefficients for terrestrial food-chain: their derivation and limitations.** Ng, Y.C.; Colsher, C.S.; Thompson, S.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1979. Contract W-7405-ENG-48. 28p. (CONF-7810179—1). Dep. NTIS, PC A03/MF A01.

From 12. annual conference of the German-Swiss Fachverband fur Strahlenschultz; Norderney, F.R. Germany (2 Oct 1978).

Transfer coefficients to predict the passage of isotopes from the environment to terrestrial foods have been derived for various radionuclides of importance in the nuclear fuel cycle. These data update and extend previously recommended handbook values. We derive transfer coefficients to terrestrial foods and describe the systematics of the derived transfer coefficients. Suggestions are offered for changes in the values of transfer coefficients to terrestrial foods that now appear in federal regulatory guides. Deficiencies in our present knowledge concerning transfer coefficients and limitations in the use of these values to ensure compliance with radiation protection standards are discussed.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 42224, 42247, 42251, 43249

REGULATIONS

REFER ALSO TO CITATION(S) 43183, 43768

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 42424

43776 (BNL—50895) **Data report: oceanographic data from moored instrumentation. Velocity and temperature off Shinnecock, Long Island in October—November 1976.** Scott, J.T.; Hopkins, T.S.; Pillsbury, R.D.; Divis, E.G. (Brookhaven National Lab., Upton, NY (USA)). May 1978. Contract EY-76-C-02-0016. 45p. Dep. NTIS, PC A03/MF A01.

An instrumented semirigid spar buoy was moored in the nearshore region off Shinnecock, Long Island, in October 1976. The mooring had four sensor packages at distributed depths recording velocity, conductivity, and temperature over hourly intervals. The averaged data were radioed to the Brookhaven National Laboratory. The operating period extended for 41 days. The results of the velocity and temperature sensors are presented in this report as: 1) time series; 2) daily mean velocity vectors; 3) progressive vector diagrams; and 4) histograms of speed and direction. The instrumentation is described, and a discussion of error is presented.

43777 (COO—3278-T1) **Phytoplankton growth, dissipation, and succession in estuarine environments. Renewal proposal and annual summary report, August 1, 1977—July 31, 1978.** Seliger, H.H. (Energy Research and Development Administration, Washington, DC (USA). Div. of Biomedical and Environmental Research). 1978. Contract EY-76-S-02-3278. 80p. Dep. NTIS, PC A05/MF A01.

The directions of the research program in understanding the dynamics of the natural phytoplankton populations of the Chesapeake Bay, the methodology, the statistical analysis, and the description of the system are parallel to the requirements for environmental impact studies. Results are reported for the following studies: development of instrumentation and the synoptic isopleth methodology for relating the dynamic distributions of natural phytoplankton populations to water circulation patterns; phytoplankton cage experiments for assessment of nutrient dynamics; sub-lethal concentrations and effects of polycyclic aromatic hydrocarbons; and studies on concentration and time kinetics of induction of liver aryl hydrocarbon hydroxylase system in Fundulus heteroclitus by benzopyrene and 3-methyl cholanthrene. (HLW)

43778 (NP—23714) **Water resources review for March 1979.** (Geological Survey, Reston, VA (USA)). Mar 1979. 24p. Dept. of the Interior, Reston, VA.

Streamflow generally increased seasonally in Idaho, Montana, Nevada, North and South Carolina, Saskatchewan, and throughout most of the Northeast, Midcontinent, and Western Great Lakes Regions. Monthly mean flows generally decreased in Alberta, Manitoba, Kentucky, Louisiana, Maryland, and Virginia, and were variable elsewhere. Above-normal streamflow occurred in the Southwest, in a broad band along the east coast from Georgia to the Atlantic Provinces, and in a large area in and adjacent to Illinois in the Midwest. Below-normal streamflow persisted in parts of Utah and decreased into that range in small areas of southern Canada, Colorado, and Montana. Mean flows were highest of record for the monthe in parts of Connecticut, Iowa, Missouri, New Brunswick, Nova Scotia, Quebec, and Texas. Flooding occurred in Alabama, Connecticut, Georgia, Illinois, Indiana, Iowa, Louisiana, Maine, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Vermont, and Wisconsin. Ground-water levels rose in the Northeast Region, and were generally above average. In parts of Maine, some of the highest levels in more than 30 years of record were reached. In the Southeast Region, trends were regionally mixed, and were above average in Kentucky, Virginia, and North Carolina, and above and below average elsewhere in the region. In the Western Great Lakes and Midcontinent Regions, rising trends prevailed, and levels were mostly above average, but below average in Ohio. In the West, trends were mixed, and levels were below average in Washington, Idaho, and Montana, but above and below average elsewhere in the region.New high ground-water levels for March occurred in Maine and Nevada, and a new alltime high level was reached in Maine and also in Kentucky. New lows for March occurred in Arizona, Arkansas, Georgia, Idaho, Kansas, Louisiana, Nevada, New Mexico, Tennessee, Texas, and Washington.

43779 (NVO—0703-2) **Mid-Pacific Marine Laboratory. Annual report for the period, 1 October 1977—30 September 1978.** Reese, E.S.; Johnson, V.R. Jr. (Hawaii Univ., Honolulu (USA). Office of Research Administration). Mar 1979. Contract EY-76-C-08-0703. 87p. Dep. NTIS, PC A05/MF A01.

Studies on behavior included reproduction and sociobiology of reef fishes and aggression, hearing, and ultrasonic telemetry in sharks. Ecological studies included population, growth, and mortality studies on birds, corals, crustacea, echinoderms, fishes, molluscs, and rats. Geochemistry studies included biogeochemistry of reef organisms and hydrogeochemistry of groundwater. Geology studies included bioerosion of sea urchins, biology of endolithic processes, and survey of soils. Oceanography studies were conducted on lagoon circulation. Physiological studies were conducted on symbiosis in corals and utilization of organic material by Foraminifera. Studies on systematics of algae, echinoderms, and fishes were conducted. (HLW)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42232, 42233, 42237, 42307, 42310, 42665, 42966, 43338, 43495, 43728, 43735, 43745, 43751, 43758, 43759, 43761, 43771, 43787, 43788, 43840, 43846

43780 (CONF-790459—6) **Simulation approach to developing wastewater-treatment cost functions.** Macal, C.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From Instrument Society of America, Pittsburgh modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1979).

This paper describes the Simulation of Waste Treatment (SWAT) Model. The model can be used as a policy planning tool to construct relationships between cost and effluent quality across technologies for a river basin. Wastewater-treatment technology is represented in detail. Costs of operation and modification in response to changes in effluent standards are simulated over a planning period. Replacement technology at the time of plant modification is selected automatically by the model considering the equipment in place at a plant and costs of alternate technologies. The model is unusual in that the interactions of pollutant treatments are explicitly considered and information on the existing treatment systems in a basin is taken into account.

43781 (COO—1599-139(Pt.1)) **Dissolved organic matter and lake metabolism. Technical progress report, 1 July 1977—30 June 1978.** Wetzel, R.G. (Michigan State Univ., Hickory Corners (USA). W.K. Kellogg Biological Station). 1978. Contract EY-76-S-02-1599. 56p. Dep. NTIS, PC A04/MF A01.

Interactions of dissolved organic matter with inorganic nutrient cycling and regulation of the photosynthetic and decompositional metabolism of micro- and macroflora remains the focal point of these studies. Major efforts are directed towards the sources, fates, pathways, and interactions of dissolved organic matter in inorganic chemical cycling; allochthonous sources, metabolism en route, and inputs to the lake systems of increasing stages of eutrophication; and the relationships of these compounds to the nutrient physiology and metabolism of phytoplankton, sessile algae, macrophytes, and bacterial populations of the littoral zones and wetlands of the drainage basin. Analyses of regulatory mechanisms of growth and rates of carbon cycling center on evaluation of quantitative control interactions among the microflora of the pelagial zones of seversal lakes of progressively greater eutrophy, littoral photosynthetic producer-decomposer complex, and allochthonous inorganic—organic influxes and their biotic processing. The underlying thesis is that quantification of the dynamic carbon fluxes among these components and their rate control mechanisms by physical and chemical factors are fundamental to elucidation of the rate functions of lake eutrophication.

43782 (NUREG/CR—0770) **Asbestos in cooling-tower waters. Final report.** Lewis, B.A.G. (Argonne National Lab., IL (USA)). Mar 1979. Contract W-31-109-ENG-38. 102p. (ANL/ES—71). Dep. NTIS, PC A06/MF A01.

Water discharges from cooling towers constructed with asbestos fill were found to contain chrysotile—asbestos fibers at concentrations as high as 10^8 fibers/liter. The major source of these fibers, appears to be the components of the towers rather than the air drawn through the towers or the makeup water taken into the towers. Suggested mechanisms for the release of chrysotile fibers from cooling-tower fill include freeze-thaw cycles and dissolution of the cement due to acidic components of the circulating water. Ash- or other material-settling ponds were found to reduce asbestos-fiber concentrations in cooling-tower effluent. The literature reviewed did not support the case for a causal relationship between adverse human health effects and drinking water containing on the order of 10^6 chrysotile—asbestos fibers/liter; for this and other reasons, it is not presently suggested that the use of asbestos fill be discontinued. However, caution and surveillance are dictated by the uncertainties in the epidemiological studies, the absence of evidence for a safe threshold concentration in water, and the conclusive evidence for adverse effects from occupational exposure. It is recommended that monitoring programs be carried out at sites where asbestos fill is used; data from such programs can be used to determine whether any mitigative measures should be taken. On the basis of estimates made in this study, monitoring for asbestos in drift from cooling towers does not appear to be warranted.

43783 (PB—287498) **Land and water use effects on ground-water quality in Las Vegas Valley. Final report 1 Nov 69—31 Jan 74.** Kaufmann, R.F. (Nevada Univ., Las Vegas (USA)). Aug 1978. 272p. NTIS PC A12/MF A01.

The hydrogeologic study of the shallow ground-water zone in Las Vegas Valley, Nevada determined the sources and extent of ground-water contamination to develop management alternatives and minimize adverse effects. An extensive, computerized data base utilizing water analyses, well logs, head measurements, and surface flows was developed. Flow system analysis, gross chemical data and tritium analyses were used in combination with trend surface techniques to ascertain natural and contaminated ground-water quality to depths of 0 to 50, 50 to 100, and 101 to 300 feet. At depths below 100 feet, the distribution of all constituents reflects natural controls. Nitrate and chloride in the zone from 0 to 50 feet are closely related to waste disposal activities, chief of which are industrial effluent, treated sewage, and septic tanks. In addition, tritium is highly indicative of return flows associated with distribution of Colorado River water in the Valley.

43784 (UCID—17744-79-2) **Chemical effluents in surface waters from nuclear power plants. Quarterly progress report.** Harrison, F.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1979. Contract W-7405-ENG-48. 18p. Dep. NTIS, PC A02/MF A01.

A second set of samples at the Surry and Salem Nuclear Power Stations was collected in January, 1979. Water, particles suspended in the water column, and bedload sediments were sampled in both the intake and discharge zones. Samples from the water column in January were less saline and had a higher particle load, and higher copper concentrations in both soluble and particulate fractions than those collected in October, 1978. In the soluble fraction of the water, the amount of Chelex-100-labile copper was greater than ASV-labile copper; both the apparent complexing capacity and dissolved organic carbon were higher in January than in October. Most of the differences can be attributed to increased runoff from land.

43785 **Chemical characterization and monitoring studies of effluents from emerging fossil fuel processes.** Clark, B.R.; Guerin, M.R. (Oak Ridge National Lab., TN). pp 148-156 of Speciality conference on: toxic substances in the air environment. Pittsburgh, PA; Air Pollution Control Association (1977).

From APCA specialty conference on toxic substances in the air environment; Cambridge, MA, USA (7 Nov 1976).

Approaches to the chemical characterization of aqueous wastes and gas phase fugitive emissions are discussed. Characterization studies are directed toward known hazardous materials or toward chemical class fractions and components deemed likely hazards from bioactivity data obtained in the development of screening methodologies. Analytical techniques include multi-component gas chromatographic profiling with element selective detectors, blind assays using biological activity data, chemical class fractionation for specific compound type characterization and use in bioassay studies, and many conventional method of chemical identification. Specific studies included: characterization of occupational exposure to polynuclear aromatic hydrocarbons (PAH) in fugitive emissions; determination of correlations between PAH content and bioactivity for several materials; analyses of volatile components in headspace gases; analyses of real and synthetic stack gas mixtures; characterization of aqueous by-products from oil shale retorting, coal liquefaction and petroleum refining; and development of bioassay inhalation devices.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 43735, 43762, 43836, 43837, 43838

43786 (SAND—79-1033) **Environmental monitoring report, Sandia Laboratories 1978.** Simmons, T.N. (Sandia Labs., Albuquerque, NM (USA)). May 1979. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

Plants and water samples were analyzed for ^{137}Cs. Plants were also analyzed for tritium. Water samples were checked for long-lived beta-emitting nuclides. The uranium content of soil samples was determined. Procedures for vegetation and water samples are described. Tables are presented to show results. Dose rates to the public were calculated for tritium and ^{41}Ar and radioactive effluent data are tabulated. (HLW)

WATER

REFER ALSO TO CITATION(S) 42437, 43761, 43783

43787 (PB—287737) **Geologic studies to identify the source for high levels of radium and barium in illinois ground-water supplies: a preliminary report. Final report.** Cartwright, K.; Specht, S.A.; Gilkeson, R.H.; Griffin, R.A.; Larson, T.E. (van Poollen (H.K.) and Associates, Littleton, CO (USA); Illinois State Geological Survey, Urbana (USA); Illinois State Water Survey, Urbana (USA)). Aug 1978. 31p. NTIS PC A03/MF A01.

Analyses of water from municipal wells in Illinois by the Illinois Environmental Protection Agency showed that more than 300 wells exceeded the upper limit for gross alpha radiation in drinking water. More than 30 wells exceeded the upper limit for barium in drinking water. High levels of radiation in ground water were more extensive in areal distribution than the high levels of barium. All of the affected wells were finished in bedrock, primarily in rocks of the Cambrian and Ordovician Systems of northern Illinois. The geologic settings in which the high levels of radiation and barium were documented indicated that the problem was not restricted to Illinoise. The source of the radiation in ground water was thought to be the natural occurrence of the radioactive elements uranium-238 and thorium-232 in the aquifer rocks. Analyses of a limited number of rock samples indicated that uranium and thorium concentrations were highest in fine-grained sediments in the aquifer systems; the highest concentration was in shales that confine the aquifer. Chemical analyses of rock samples indicated that high concentrations of barium were widespread in rocks of the Cambrian and Ordovician Systems. The concentration of barium in ground water was controlled by solubility equilibria reactions with sulfate ion. A map showing sulfate ion concentration in the Cambrian-Ordovician Aquifer could be used to delimit regions where barium might occur at concentrations exceeding 1 milligram/liter.

43788 (PNL—2899) **Radiological status of the ground-water beneath the Hanford Project, January—December 1978.** Eddy, P.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 81p. Dep. NTIS, PC A05/MF A01.

An evaluation of the status of ground-water contamination resulting from Hanford's onsite discharges is presented. Data collected during 1978 describe the movement of major plumes (β/sub t/, ^3H, NO_3) that respond to the influences of ground-water flow, ionic dispersion, and radioactive decay. The total beta plume continues to recede, with the exception of a beta source that is beginning to show up in the 300 Area, a result of minor spills and leaks. The tritium plume continues to expand and is mapped as having reached the Columbia River, although its contribution to the river cannot be distinguished from that attributable to atmospheric fallout. The plume now shows much the same configuration as in 1977. The nitrate plume shows general stability relative to its size with concentrations in the vicinity of the 100-H Area continuing to be high as a result of leaks from the evaporation facility. The results of a study to determine the vertical distribution of contaminants in the Hanford ground-water system indicate that the majority of contaminants are stratified in the upper portions of the unconfined aquifer.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 43759, 43765, 43832

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 42665, 42961

43789 **Case studies of thermal discharges.** Zimmermann, C. (Lahmeyer International GmbH, Frankfurt am Main, Germany); Geldner, P. pp 151-174 of Thermal effluent disposal from power generation. Zaric, Z.P. (ed.). Washington, DC; Hemisphere Publishing Corporation (1978).

From International advanced course on heat disposal from power generation; Dubrovnik, Yugoslavia (23 Aug 1976).

Since discharge of cooling water in Germany is handled from the river bank, design of the outlet is the most important factor in regard to meeting standards on plume temperature and velocity. General criteria and practical solutions for outlet structures together with studies on their effect on the plume are discussed.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 42849, 43198, 43776

REGULATIONS

REFER ALSO TO CITATION(S) 43768

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 42846, 42959, 42960, 43246

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 42313, 42527, 42665, 43180, 43181, 43186, 43187, 43245, 43793

43790 (BNL—25997) **Mortality, migration, income, and air pollution: a comparative study.** Bozzo, S.R.; Novak, K.M.; Galdos, F.; Hakoopian, R.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). 2 Jun 1978. Contract EY-76-C-02-0016. 34p. (CONF-771082—2). Dep. NTIS, PC A03/MF A01.

From 105. American Public Health Association; Washington, DC, USA (30 Oct 1977).

The interrelationships among different demographic factors, specific causes of death, median family income, and estimated air pollution emissions were examined. Using the Medical Data Base (MEDABA) developed at Brookhaven National Laboratory, the entire population of the United States was cross-tabulated by income and emission levels of air pollutants. Path analysis was used to examine a number of patterns and relationships for each age, race, and sex group containing a minimum of 10,000 persons. Competitive and complementary effects were observed. These effects were frequently age dependent and occasionaly sex related. This specialized data base, the application of path analysis, and the development of a dynamic population and mortality model, in combination, proved to be a useful tool for investigating the effects of energy related pollutants on the exposed population.

43791 (ORO—4398-T1) **Energy basis of disasters and the cycles of order and disorder.** Alexander, J.F. Jr. (Florida Univ., Gainesville (USA)). 1978. Contract EY-76-S-05-4398. 247p. Dep. NTIS, PC A11/MF A01.

A quantitative theory of cycles order and disorder was applied to the earth and evaluated to form an energy basis for the global cycles, surges, and disasters. Energy circuit language was used to diagram the world system and show a common pattern in the order—disorder processes. Storms, floods, forest fires, volcanic eruptions, earthquakes, urban fires, and wars were modeled as the catastrophic release of energy previously converged and stored. Released energy disordered and recycled material available to stimulate a new cycle of growth. Cascading of catastrophic processes of disasters was modeled with a world web. The feedback in the global energy web was provided by the control action of disaster pulses. The global model was presented in both diagrammatic and differential equation form with the energy flows and storages evaluated. Order—disorder models of the atmospheric, oceanic, biological, geological, and urban systems of earth were connected to form an energy convergence network. The global energy model was used to calculate energy quality factors (ratio of energy of one type generating energy of another type) for the earth's major energy transformations. The theory provided suggestions for land-use policy. Energy ratios that provide a quantitative basis for disaster planning can be developed for a local environment of pulsing energy. Possibilities were considered that cycles of order and disorder of the earth are synchronized by cycles of sunspots. Energy quality and pulse amplifier ratios of solar flares may be high enough to control many global cycles.

43792 (PB—287633) **The impact of energy development on recreation use and value in the Glen Canyon National Recreation Area. Lake Powell Research Project Bulletin.** Brookshire, D.S.; Schulze, W.D.; Ives, B.C. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Nov 1976. 73p.

Proposed energy projects have included several large coal-fired power plants in south central Utah. New plants in such regions give rise to stresses and conflicts among the objectives of energy production, regional economic development, and maintenance and enhancement of recreational resources and environmental quality. A dynamic regional model was developed to examine quantitatively several aspects of these conflict situations.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 42665, 43193

43793 (DOE/TIC—10129) **Impact of national energy and environmental policies on industry location dynamics. A methodological review.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1979. Contract EJ-78-C-01-2833. 222p. Dep. NTIS, PC A10/MFA01.

This report presents the findings of a study performed to assess the pertinent theoretical and empirical literature on industry location dynamics, with emphasis on energy-intensive industries, in order to help guide DOE's subsequent research activities in analyzing the impact of national energy and environmental policies on industrial location and regional growth patterns. The nine chapters are entitled: Summary; Identification of Energy-Intensive Industries for Analytical Emphasis; National Energy Policies and Their Implications for the Dynamics of Industrial Location; Environmental Regulations and Their Implications for the Dynamics of Industrial Location for Energy-Intensive Industries; Industrial Location Theory: An Overview; Empirical Analyses of Industrial Location: Partial Equilibrium Location; Empirical Analyses of the Dynamics of Industrial Location: General Equilibrium Approaches; Demonstration I: A Partial Equilibrium Approach to an Analysis of the Impact of Energy Policies on the Dynamics of Industrial Location: and Demonstration II: Experimental Illustrative Application of the Partial Equilibrium Approach.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 42436

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 43719, 43779, 43848

43794 (UCID—18183) **Optimal time—energy allocation and the evolution of colony demography among eusocial insects.** Macevicz, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 May 1979. Contract W-7405-ENG-48. 150p. Dep. NTIS, PC A07/MF A01.

Thesis.

This thesis attempts to explain the evolution of certain features of social insect colony population structure by the use of optimization models. Two areas are examined in detail. First, the optimal reproductive strategies of annual eusocial insects are considered. A model is constructed for the growth of workers and reproductives as a function of the resources allocated to each. Next the allocation schedule is computed which yields the maximum number of reproductives by season's end. The results indicate that if there is constant return to scale for allocated resources the optimal strategy is to invest in colony growth until approximately one generation before season's end, whereupon worker production ceases and reproductive effort is switched entirely to producing queens and males. Furthermore, the results indicate that if there is decreasing return to scale for allocated resources then simultaneous production of workers and reproductives is possible. The model is used to explain the colony demography of two species of wasp, Polistes fuscatus and Vespa orientalis. Colonies of these insects undergo a sudden switch from the production of workers to the production of reproductives. The second area examined concerns optimal forager size distributions for monomorphic ant colonies. A model is constructed that describes the colony's energetic profit as a function which depends on the size distribution of food resources as well as forager efficiency, metabolic costs, and manufacturing costs.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 43549, 43810, 43817, 43844

43795 (BNL—25851) **Synthesis of [^{18}F]-5-fluorouridine (F-18-5-FUR) as a probe for measuring RNA synthesis and tumor growth rates in vivo.** Shiue, C.Y.; Fowler, J.S.; MacGregor, R.R.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 8p. (CONF-790321—7). Dep. NTIS, PC A02/MF A01.

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

A method for the rapid synthesis of high specific activity of [^{18}F]-5-fluorouridine is described. The ^{20}Ne(d,α)^{18}F nuclear reaction is used to produce high specific activity, anhydrous [^{18}F]-F_2 at the Brookhaven National Laboratory 60″ cyclotron. Fluorination of 2′,3′,5′-tri-0-acetyluridine with [^{18}F]-F_2 in glacial acetic acid at room temperature followed by hydrolysis with sodium methoxide in methanol gives [^{18}F]-5-fluorouridine with a radiochemical yield of 5 to 7% in a synthesis time of 90 minutes from EOB. The compound is required for the study of RNA synthesis and tumor growth rates in vivo.

43796 (CONF-790456—1) **Proteolysis of a multienzyme conjugate: a possible mechanism for breaking a metabolic channel.** Vitto, A.; Gaertner, F.H. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

From Symposium on cell compartmentation and metabolic channeling; Thuringia, F.R. Germany (7 Apr 1979).

The arom enzyme conjugate of Neurospora crassa is a polyfunctional protein that catalyzes five sequential reactions in the biosynthesis of the aromatic amino acids. Four of the five enzymes have been shown to be activated by the first substrate. In addition, evidence has been obtained in vivo and in vitro that the conjugate compartmentalizes and thereby channels its intermediate substrates. A third unique property observed for this enzyme system is that of coordinate protection by the conjugate's first substrate. All five activities are protected against proteolytic inactivation by the first substrate. Inactivation is essentially first-order, but in some instances it occurs only after a lag period. Selective inactivation of shikimate kinase, the most sensitive activity, is proposed as a regulatory mechanism that allows the cell to break the metabolic channel imposed by the conjugate in times of energy deficit. Such a break would allow the flow of carbon to be diverted from the energy-consuming aromatic amino acid biosynthetic pathway to an energy-yielding catabolic route.

43797 (LBL—8484) **Interaction of the Eco R1 restriction enzyme from E. coli with nucleotides.** Hollis, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 157p. Dep. NTIS, PC A08/MF A01.

Thesis.

The Eco R1 restriction enzyme can be shown to be inhibited by nucleotides which correspond to any part of its known site of phosphodiesterase activity. A series of di-, tetra-, and hexa-nucleotide fragments were synthesized and their effect on the activity of the enzyme upon superhelical Col E1 DNA studied. The inhibition caused by the individual mononucleotides was also studied. In general all the nucleotide fragments showed some form of interaction with the enzyme system. Tetranucleotides were stronger inhibitors than dinucleotides, which in turn were stronger inhibitors than the mononucleotides. Within each category of inhibitors, those containing the phosphodiester bond which is acted upon by the enzyme were the strongest inhibitors. Only those fragments which were consistent with the enzymes' site of activity showed competitive inhibition kinetics. Nucleotides which do not fit within the site of phosphodiesterase activity show non-competitive inhibition kinetics.

43798 (LBL—8953) **Theoretical studies of the light reactions in photosynthesis.** Friesner, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 198p. Dep. NTIS, PC A09/MF A01.

Thesis.

The light reactions of photosynthesis were studied by electron paramagnetic resonance spectroscopy (EPR). The author's original contributions are primarily in two areas; development of magnetic resonance formalism, and utilization of theoretical formulations to interpret EPR spectra arising from photosynthetic systems. The latter analysis has provided information about the orientations, interactions, and identity of the electron transport cofactors involved in the photosynthetic light reactions in both green plants and photosynthetic bacteria. The magnetic resonance formalism which is used throughout is briefly outlined, and a short introduction to the light reactions of photosynthesis is given. A general method of determining the orientational distribution function of a partially ordered ensemble of paramagnetic systems from its EPR lineshape is developed. A prescription is also given for determining the relationship of the principal magnetic axis system (PMAS) of the paramagnetic species to the preferred alignment direction of the ensemble if this is not already known. The theory developed is applied to a partially ordered ensemble of triplet states localized on the primary donor in photosynthetic bacteria. Ordering is achieved by magnetic field orientation or magnetophotoselection. An analysis of the spectrum from a randomly oriented ensemble allows determination of the D and E values of the triplet and the relative intersystem crossing rates K/sub x/:K/sub y/:K/sub z/. An analysis is given of a spin polarized EPR signal arising from photosystem I (PSI) of higher plants which can be observed in chloroplast suspensions. A radical pair theory of spin polarization for systems of membrane bound radicals with anisotropic g tensors is developed, and used to explain the orientation dependence of the lineshape of the polarized signal.

43799 (LBL—9079) **Chemical track effects in condensed systems and implications for biological damage.** Magee, J.L.; Chatterjee, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

An overview of heavy particle tracks is given and present concepts of the local space-time development following a small isolated energy loss in water are presented by means of a diagram. A summary of heavy particle radical diffusion calculations is presented. A model explaining all survival in terms of radical diffusion processes is described. (HLW)

43800 (UCLA—12-1167) **Structure-function relationships of proteinase from soybean (Bowman-Birk) and lima bean: modification by N-acetylimidazole.** Kay, E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1978. Contract EY-76-C-03-0012. 18p. Dep. NTIS, PC A02/MF A01.

Contributions of tyrosyl residues to trypsin- and chymotrypsin-inhibitory activities in two homologous proteinase inhibitors were investigated by modifying them with N-acetylimidazole under various conditions. In Bowman-Birk soybean proteinase inhibitor, Tyr 55, immediately following the antichymotryptic site Leu 53-Ser 54, is relatively inaccessible to N-acetylimidazole and can only be acetylated in the presence of 6 M guanidine hydrochloride but not in 8 M urea. The acetylation of Tyr 55 is accompanied by 60% loss in antichymotryptic activity. Deacetylation with hydroxylamine restores the activity to the original level. Tyr 69, located in the antitrypsin portion of the inhibitor, is relatively exposed to N-acetylimidazole and can be acetylated without denaturing agent. The acetylation of Tyr 69 parallels decrease in antitryptic activity. The

inhibitor acetylated at Tyr 69 is fully active toward chymotrypsin and has 30 to 40% antitryptic activity of the native. The original level of antitryptic activity is restored upon deacetylation. Tyr 69 of lima bean proteinase inhibitor is relatively inaccessible to N-acetylimidazole: 75% acetylation in the presence of 6 M guanidine hydrochloride and 17% without the denaturing agent. The acetylated inhibitor is fully active toward chymotrypsin but retains only 29% (acetylated without guanidine hydrochloride) and 17% (acetylated with guanidine hydrochloride) of the original antitryptic activity. Deacetylation partially restores the lost antitryptic activity in the inhibitor acetylated without the denaturing agent.

43801 (UR—3490-1549(Vols.1-2)) **Calcium transport in vesicles energized by cytochrome oxidase.** Rosier, R.N. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 357p. Dep. NTIS, PC A16/MF A01.

Experiments on the reconstitution of cytochrome oxidase into phospholipid vesicles were carried out using techniques of selectivity energizing the suspensions with ascorbate and cytochrome c or ascorbate, PMS, and internally trapped cytochrome c. It was found that the K^+ selective ionophore valinomycin stimulated the rate of respiration of cytochrome oxidase vesicles regardless of the direction of the K^+ flux across the vesicle membranes. The stimulation occurred in the presence of protonophoric uncouplers and in the complete absence of potassium or in detergent-lysed suspensions. Gramicidin had similar effects and it was determined that the ionophores acted by specific interaction with cytochrome oxidase rather than by the previously assumed collapse of membrane potentials. When hydrophobic proteins and appropriate coupling factors were incorporated into the cytochrome oxidase, vesicles phosphorylation of ADP could be coupled to the oxidation reaction of cytochrome oxidase. Relatively low P:O, representing poor coupling of the system, were problematical and precluded measurements of protonmotive force. However the system was used to study ion translocation.

43802 **Pyrimidine nucleoside, pseudouridine, and modified nucleoside excretion by growing and resting fibroblasts.** Uziel, M.; Selkirk, J.K. (Oak Ridge National Lab., TN). *J. Cell. Physiol.;* **99**: No. 2, 217-222(May 1979).

We are examining the relationship of RNA metabolism and de novo pyrimidine synthesis as parameters of malignant transformation. These initial experiments on normal hamster embryo fibroblasts have shown that excreted nucleosides are markers for intracellular RNA metabolism. We employed affinity chromatography to concentrate the nucleosides in the medium and sensitive column chromatographic procedures to quantitatively measure them. The excretion of pyrimidine nucleoside from hamster embryo fibroblasts in culture was found to be dependent on the growth stage of the cells, with the greatest accumulation occurring during cell quiescence. The major nucleosidee excretion products, uridine and cytidine, were both normal end products of RNA metabolism and the major nucleoside excretion products from cultured cells. The modified nucleosides N-1-methylguanosine, N-2-methylguanosine, N-2-dimethylguanosine, N-4-acetylcytidine, N-1-methylinosine, pseudouridine, N-1-methyladenosine, N-3-methylcytidine, and 5-methylcytidine were found, as were several unidentified nucleosides.

43803 **Linear dichroism of electric field oriented bacteriochlorophyll a-protein from green photosynthetic bacteria.** Whitten, W.B. (Oak Ridge National Lab., TN); Pearlstein, R.M.; Phares, E.F.; Geacintov, N.E. *Biochim. Biophys. Acta;* **503**: 491-498(1978).

Bacteriochlorophyll α-protein from Prosthecochloris aestuarii strain 2K was oriented in a pulsed electric field. The room temperature linear dichroism spectrum of the oriented protein in the Q/sub y/ region of the bacteriochlorophyll α absorption exhibts a single asymmetrical peak at 813 nm with a shoulder extending to the blue. The ≈ 12 nm fullwidth of the linear dichroism peak is only about half that of the 300 K absorption spectrum. The linear dichroism at 813 nm was not saturated at field strengths of up to 15 kV/cm. The time dependence of the linear dichroism suggests that the orienting particles are aggregates of at least some tens of bacteriochlorophyll a-protein trimers. The linear dichroism peak coincides in wavelength with the 813-nm peak of the 300 K, 4th derivative absorption spectrum of the protein and is therefore attributed to the bacteriochlorophyll a Q/sub y/ exciton transition observed in absorption at the same wavelength.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43795

CYTOLOGY

REFER ALSO TO CITATION(S) 43798, 43821

43804 (LA—7791-PR) **Application of cell analysis and sorting techniques to disease detection. Progress report, October 1, 1977—September 30, 1978.** Forslund, J.C.; Brake, E.T.; Cram, L.S. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

Significant progress has been made on the development and characterization of a cell-mediated assay for bovine tuberculosis. Using a whole blood culture technique, lymphocyte proliferation in response to a purified protein derivative from Mycobacterium avium (PPD-A) or Mycobacterium bovis (PPD-B) was measured. The analysis was done by flow microfluorometry of fluorescently stained lymphocyte DNA. Samples from experimentally infected animals and field cases were evaluated using this procedure. Optimization of the protocol is reported and investigations into new diagnostic techniques are reported.

43805 (LA-UR—79-1069) **Models for the interaction between cells of the immune system.** Bell, G.I. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 10p. (CONF-7805177—1). Dep. NTIS, PC A02/MF A01.

From Systems theory in immunology conference; Rome, Italy (29 May 1978).

The following topics are discussed: mathematical models of cell-to-cell interactions; role of cell-to-cell contacts in regulating immune responses; cell-to-cell binding; the strength of specific bonds; rate of bond formation; and effects of binding on cell behavior. It is concluded that receptor accumulations are to be expected in areas of cell—cell contact. Gross alterations in membrane properties in these contact caps may result. (HLW)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43547

GENETICS

REFER ALSO TO CITATION(S) 43822, 43833

METABOLISM

REFER ALSO TO CITATION(S) 43796, 43843

43806 (LBL—8594) **Report to the William and Flora Hewlett Foundation.** Eisner, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1978. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

A biological model is presented for determining effects of an environmetal variable on a physiological variable. The effect of an environmental variable, temperature, on a physiological variable, oxygen consumption, was studied. (HLW) Measurements were made on oxygen consumption of mice following exposure to different temperatures. A graph is presented to show results. A model was developed to show: thermal regulation; ratio of change in heat production to change in body temperature; thermal capacity of the body; heat transfer coefficient of the fur; and volume of oxygen required to produce a unit of heat by metabolism. The relevance of the results to ecosystems is discussed.

TRACER TECHNIQUES

43807 **Effect of dietary cadmium on calcium metabolism in the rat during late gestation.** Kelman, B.J.; Walter, B.K.; Jarboe, G.E.; Sasser, L.B. (Comparative Animal Research Lab., Oak Ridge, TN). Contract EY-76-C-05-0242. *Proc. Soc. Exp. Biol. Med.;* **158**: 614-617(1978).

Sprague—Dawley rats were given access to water containing control, 10, 25 ppM Cd beginning on day 0 of gestation. On day 21 of gestation, fetal and maternal tissues were collected from dams which had been dosed 24 hr previously with 16 μCi of $^{45}CaCl_2$. Maternal and fetal hematocrits decreased, indicating a possible interference with iron metabolism. No changes in total or radiocalcium found in fetal body were detected as a function of Cd treatment. Fetal bone stable and radiocalcium increased by as much as 33% at 25 ppM while fetal liver and kidney stable Ca decreased compared to controls. It is evident that low Cd exposures lead to changes in fetal Ca metabolism rather than causing changes in the amount of Ca transported across the placenta.

MEDICINE

REFER ALSO TO CITATION(S) 43829

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 43547, 43577, 43835

43808 (BNL—25819) **Clinical needs in functional imaging.** Atkins, H.L.; Fairchild, R.G.; Richards, P.; Pate, H. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 19p. (CONF-790321—6). Dep. NTIS, PC A02/MF A01.

From 2. international symposium on radiopharmaceuticals; Seattle, WA, USA (18 Mar 1979).

Emission tomography, with positron or single photon emitting radionuclides, offers the possibility of quantitation, a necessary ingredient for functional studies. A figure of merit has been devised as an aid in selecting radionuclides that offer the greatest photon yield for the lowest radiation dose because emission tomography requires a greater information density than conventional imaging. Alterations in function generally precede anatomical alterations and functional imaging may therefore be a more sensitive method of investigating disease processes.

43809 (UCLA—12-1176) **Emission computed tomography: a new technique for the quantitative physiologic study of brain and heart in vivo.** Phelps, M.E.; Hoffman, E.J.; Huang, S.C.; Schelbert, H.R.; Kuhl, D.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1978. Contract EY-76-C-03-0012. 35p. Dep. NTIS, PC A03/MF A01.

Emission computed tomography can provide a quantitative in vivo measurement of regional tissue radionuclide tracer concentrations. This facility when combined with physiologic models and radioactively labeled physiologic tracers that behave in a predictable manner allow measurement of a wide variety of physiologic variables. This integrated technique has been referred to as Physiologic Tomography (PT). PT requires labeled compounds which trace physiologic processes in a known and predictable manner, and physiologic models which are appropriately formulated and validated to derive physiologic variables from ECT data. In order to effectively achieve this goal, PT requires an ECT system that is capable of performing truly quantitative or analytical measurements of tissue tracer concentrations and which has been well characterized in terms of spatial resolution, sensitivity and signal to noise ratios in the tomographic image. This paper illustrates the capabilities of emission computed tomography and provides examples of physiologic tomography for the regional measurement of cerebral and myocardial metabolic rate for glucose, regional measurement of cerebral blood volume, gated cardiac blood pools and capillary perfusion in brain and heart. Studies on patients with stroke and myocardial ischemia are also presented.

43810 Demonstration of lactoferrin in tumor tissue from two patients with positive gallium scans. Hoffer, P.B.; Miller-Catchpole, R.; Turner, D.A. (Yale Univ., New Haven, CT). Contract EP-78-S-02-4625. *J. Nucl. Med.;* **20**: No. 5, 424-427(May 1979).

We have detected lactoferrin in tumor tissue from a patient with Hodgkin's disease and a patient with Burkitt's lymphoma. Both patients had radiogallium scans demonstrating increased uptake in the tumor tissue subsequently found to contain lactoferrin. Tissue assay for lactoferrin was performed by the indirect immunofluorescence method. Control splenic tissue showed either slight lactoferrin content or none.

43811 Demonstration of gastroesophageal reflux in children by radionuclide gastroesophagography. Rudd, T.G.; Christie, D.L. (Children's Orthopaedic Hospital, Seattle, WA). *Radiology;* **131**: No. 2, 483-486(May 1979).

Twenty-five infants and children with proved gastroesophageal reflux were studied by radionuclide gastroesophagography to determine its sensitivity in detecting reflux. Patients swallowed an inert radiotracer (Tc-99m sulfur colloid) and gamma camera images of the stomach and esophagus were made with and without abdominal pressure. The test was easy to perform and was well tolerated. Reflux was demonstrated in 20 patients (80%); this compared favorably with barium gastroesophagography.

43812 Cardiac imaging with tantalum-178. Holman, B.L.; Neirinckx, R.D.; Treves, S.; Tow, D.E. (Harvard Medical School, Boston, MA). *Radiology;* **131**: No. 2, 525-526(May 1979).

Tantalum-178 is a potential tracer for the first transit studies of the heart. It has a short physical half-life (9.3 minutes) and is obtained as a generator product from its long-lived (21.3 days) parent, tungsten-178. First transit studies were performed in the monkey and dog following the intravenous injection of 20 mCi (740 MBq) of tantalum-178. Imaging was performed with a large field of view single crystal camera and a multicrystal camera. Pulmonary dilution curves were derived for the analysis of left-to-right intracardiac shunting and high temporal resolution studies were obtained to assess left ventricular function and to measure left ventricular ejection fraction. The short physical half-life of tantalum-178 permits multiple sequential studies with reduced patient radiation dose compared to the current radionuclide of choice, technetium-99m.

43813 Imaging experimental infective endocarditis with indium-111-labeled blood cellular components. Riba, A.L.; Thakur, M.L.; Gottschalk, A.; Andriole, V.T.; Zaret, B.L. (Yale Univ. School of Medicine, New Haven, CT). *Circulation;* **59**: No. 2, 336-343(Feb 1979).

The capability of radionuclide imaging to detect experimental aortic valve infective endocarditis was assessed with indium-111 (^{111}In)-labeled blood cells. Sequential cardiac imaging and tissue distribution studies were obtained in 17 rabbits with infective endocarditis after administration of ^{111}In-platelets and in five after ^{111}In-polymorphonuclear leukocytes. Forty-eight to 72 hours after platelet administration, in vivo imaging demonstrated abnormal ^{111}In uptake in all animals in the region of the aortic valve in an anatomically distinct pattern. Images of the excised heart showed discrete cardiac uptake conforming to the in vivo image and gross pathological examination. ^{111}In-platelet uptake in vegetations from the 17 animals averaged 240 +- 41 times greater than that in normal myocardium and 99 +- 15 times greater uptake in blood. In contrast, ^{111}In-leukocyte cardiac imaging showed no abnormal aortic valve uptake 24 hours after tracer administration and the lesion myocardium activity ratio was only 5 +- 2 (3 +- 1 for lesion/blood activity). Four normal rabbits demonstrated neither positive ^{111}In-platelet scintigraphs nor abnormal cardiac tissue uptake. Likewise, noncellular ^{111}In was not concentrated to any significant extent in three animals with infective endocarditis. This study demonstrates that ^{111}In-platelet, but not leukocyte cardiac imaging, is a sensitive technique for detecting experimental infective endocarditis. The imaging data conform to the cellular pathology of the infective endocarditis vegetation.

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 43811, 43830

43814 (CONF-770942—2) **Comparison of laboratory and clinical evaluations of mammographic screen-film systems.** Sickles, E.A.; Genant, H.K.; Doi, K. (California Univ., San Francisco (USA); Chicago Univ., IL (USA)). 1977. 6p. Dep. NTIS, PC A02/MF A01.

From SPIE/SPSE conference on application of optical instrumentation in medicine; Boston, MA, USA (25 Sep 1977).

The widely used DuPont Lo-dose mammography screen-film system was compared with four combinations of higher efficiency screens and single-emulsion films. Laboratory comparisons of the basic image properties (resolution, noise, contrast) of all these screen-film combinations were made both qualitatively (images of microwire meshes, tiny plastic beads, step wedges) and quantitatively (modulation transfer functions, Wiener spectra, step wedge optical density differences). Subjective single-blind estimations of resolution, noise, and contrast were also made directly from the mammograms of 100 consecutive patients radiographed with each of the five screen-film combinations. Both laboratory and clinical evaluations of image quality showed strikingly similar results: improved contrast, minimally reduced resolution, and varying degrees of increased noise for each of the high efficiency recording systems. Similarities between the results of laboratory and clinical studies should help to establish the clinical relevance of the laboratory analyses, and recognition of the relative precision of the clinical evaluations should allow for their use in place of laboratory studies when sophisticated physics support is not available.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 42637, 42849, 43338, 43796, 43798

43815 (ANL/EES-TM—38) **Fusarium species: their potential for transforming biomass to ethanol.** Antonopoulos, A.A. (Argonne National Lab., IL (USA)). Feb 1979. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

The purpose of this study was to review existing literature and present some considerations pertaining to the use of Fusarium in degrading and fermenting certain biomass constituents to ethanol. Energy stored in the carbon bonds of biomass can be extracted in a form usable as fuel by several fungal species. Members of the genus Fusarium (tubercullariaceous deuteromycetes) have demonstrated their ability to depolymerize macromolecular carbohydrates and lignin and to ferment monosaccharides to ethanol. Research has focused on decomposition of cellulose, hemicellulose, pectic substances and lignin by several formae speciales of Fusarium oxysporum, as well as on ethyl alcohol production by fermenting hexoses and pentoses. In this context, the exceptional capabilities of Fusarium species have been emphasized by students of fungal biochemistry. Unlike yeasts and other fungi, Fusaria can ferment both

pentoses and hexoses (yeast can ferment only hexoses), and are able to saccharify the cell wall and middle lamella constituents and ferment the released sugar units. Existing research data support well the idea of utilizing selected Fusarium strains to decompose and convert biomass to ethyl alcohol. Since ethanol blends and performs effectively with gasoline (as gasohol), its yield through the Fusarium fermentative action should be exploited. There are certain biological, technological, and economic limitations that constrain the application of biomass conversion to ethanol by Fusarium strains today on a large scale. These obstacles, however, could be overcome through additional research and development.

43816 (DP-MS—78-93) **Isolation of legionnaires' disease bacteria from non-epidemic related habitats.** Fliermans, C.B.; Cherry, W.B.; Orrison, L.H.; Thacker, L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Center for Disease Control, Altanta, GA (USA)). 1979. Contract EY-76-C-09-0001. 11p. (CONF-790521—1). Dep. NTIS, PC A02/MF A01.

From American Society for Microbiology; Los Angeles, CA, USA (7 May 1979).

Continuous centrifugation of large volumes of water from natural southeastern lakes allowed quantitative screening for Legionnaires' disease bacteria (LDB) by direct immunofluorescent staining. Presumptively positive samples were injected intraperitoneally into guinea pigs and the LDB were isolated and identified by their morphological, cultural, physiological, and serological characteristics.

43817 **Relationships among different strains of T7 and among T7-related bacteriophages.** Studier, F.W. (Brookhaven National Lab., Upton, NY). *Virology;* **95**: No. 1, 70-84(May 1979).

DNAs of the related bacteriophages T7, T3, PHI II, H, PHI I, and W31 have been cut with the restriction endonuclease HpaI and the DNA fragments analyzed by gel electrophoresis. A characteristic pattern of fragments was produced from each DNA, only PHI II and H DNA giving patterns that were obviously related to each other. Thus HpaI restriction patterns can be used to provide rapid and positive identification of these closely related phages. Restriction analysis, together with plating behavior and biochemical characteristics, has revealed a remarkable diversity among strains of the same phage from different laboratories. Of T7 strains received from 19 sources only 8 corresponded to the original wild-type T7, the others being different pure deletion mutants of T7, mixtures of wild-type and different mutants, one host-range mutant, and two strains that were actually T3. Divergence in different lines of other T7-related phages was also observed, as were same additional cases of mistaken identity. Deletions in the gene 0.7 region seem to be a common type of change in all of the T7-related phages. Some misconceptions that have arisen because of strain differences or cases of mistaken identity can now be corrected. Some of the best previous measurements of the molecular weight of T7 DNA were apparently made on DNA from deletion mutants, leading to a commonly accepted value for the molecular weight of T7 DNA that is too low. The T7-related phages are generally thought to be female specific, but in fact authentic T3 plates equally well on isogenic male and female strains of Escherichia coli.

PATHOLOGY

REFER ALSO TO CITATION(S) 43833

43818 (UCRL-Trans—11466) **Examination of the semen of husbands of habitually aborting women.** Czeizel, E.; Hancsok, M.; Viczian, M. Translated from *Orv. Hetil.;* **108**: 1591-1595(1967). 17p. Dep. NTIS, PC A02/MF A01.

The authors describe the obstetric aspects of spermatology and discuss the assumed connection between pathospermia and fetal damage. Semen of the husbands of 50 habitually aborting women was examined. In seven of these men the proportion of teratoid spermatozoa exceeded the upper limit of the physiological range (20%), and six of these men also showed oligospermia. It can be assumed that in these seven cases pathospermia was responsible for the fetal damage. It is believed that the teratoid forms are incapable of fertilization, but their increased frequency is an indicator of pathological spermatogenesis. The fact is that, in the case of pathological spermatogenesis, one must bear in mind some microscopically undetectable biochemical irregularities, the effects of which are not manifested until embryonic or fetal development, when they can cause damage to the embryo or fetus.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 43798, 43818, 43834

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 43338

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 42224, 42637, 43196, 43325, 43338, 43738, 43843

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 43500

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

43819 (USGS—474-261) **Supplementary lithologic logs of selected vertical drill holes in area 12, Nevada Test Site.** Maldonado, F.; Steele, S.G.; Townsend, D.R. (Geological Survey, Denver, CO (USA); Fenix and Scisson, Inc., Mercury, NV (USA)). Mar 1979. Contract EY-76-A-08-0474. 77p. Dep. NTIS, PC A05/MF A01.

Lithologic data were collected from drill holes in the Rainier and Aqueduct Mesas, Area 12, Nevada Test Site since 1970. Data presented in this report include locations and lithologies for 1 slant and 22 vertical drill holes greater than 152.4 m (500 ft) in depth in these areas. 3 figures, 1 table.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

43820 (CONF-790229—2) **Cells, targets, and molecules in radiation biology.** Elkind, M.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 62p. Dep. NTIS, PC A04/MF A01.

From 32. annual symposium on fundamental cancer research; Houston, TX, USA (27 Feb 1979).

Cellular damage and repair are discussed with regard to inactivation models, dose-effect curves and cancer research, repair relative to damage accumulation, potentially lethal damage, repair of potentially lethal vs. sublethal damage, cell killing and DNA damage due to nonionizing radiation, and anisotonicity vs. lethality due to nonionizing radiation. Other topics discussed are DNA damage and repair in cells exposed to ionizing radiation, kinetics of repair of single-strand DNA breaks, effects of actinomycin D on x-ray survival curve of hamster cells, misrepair and lethality, and perspective and prospects. (HLW)

43821 (CONF-7805128—1) **Assessing chemical mutagens: the risk to humans.** Brewen, J.G. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

From Symposium on cytogenetics studies and risk assessment for chemical mutagens and ionizing radiation; Spring Harbor, NY, USA (14 May 1978).

Some topics discussed are as follows: chromosomal aberrations induced by x radiation, tritiated thymidine, maleic hydrazide, and nitrogen mustard; removal of pyrimidine dimers by photoreactivation in amphibian cells following uv radiation; effects of 4-nitroquinoline-oxide on leukocytes from XP and normal patients; DNA as a target for alkylating agents; sensitivity of spermatogonia to chemical mutagens; chromosomal aberrations induced by 8-ethoxycaffeine, methoxycaffeine, cytosine arabinoside, streptonigrin, bleomycin, and phleomycin; effects of MMS and triethylenemelamine on germ cells; and use of chromosomal aberrations for improving risk estimates for ionizing radiation. (HLW)

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

43822 (BNL—25840) **DNA repair.** Setlow, R. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 16p. (CONF-7805128—2). Dep. NTIS, PC A02/MF A01.

From Symposium on cytogenetics studies and risk assessment for chemical mutagens and ionizing radiation; Spring Harbor, NY, USA (14 May 1978).

Some topics discussed are as follows: difficulty in extrapolating data from E. coli to mammalian systems; mutations caused by UV-induced changes in DNA; mutants deficient in excision repair; other postreplication mechanisms; kinds of excision repair systems; detection of repair by biochemical or biophysical means; human mutants deficient in repair; mutagenic effects of UV on XP cells; and detection of UV-repair defects among XP individuals. (HLW)

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 43772

43823 (COO—3173-18) **Pathophysiologic effects of stable iodine used as a thyroidal blocking agent to reduce thyroid radiation exposure. Final progress report, November 1, 1976—December 31, 1977.** Becker, D.V.; Hurley, J.R. (Cornell Univ., New York (USA). Dept. of Medicine). 1977. Contract EY-76-S-02-3173. 29p. Dep. NTIS, PC A03/MF A01.

In order to determine whether acute administration of iodide leads to any undesirable effects in the general population, we studied a group of patients who received iodinated radiographic contrast medium in the course of routine x-ray diagnostic procedures. We were particularly interested in investigating the possibility that administration of iodine could damage thyroid follicular cells leading to release of intrathyroidal antigens such as thyroglobulin into the blood. An increase in serum thyroglobulin might, in turn, either initiate or exacerbate thyroid autoimmunity in susceptible individuals, leading to autoimmune thyroiditis. We looked for undesirable effects due to the administration of iodide in 3 ways: a possible acute toxic effect on thyroid follicular cells was investigated by determining serum thyroglobulin immediately prior to and 24 hours after injection of iodinated contrast medium; an effect on thyroid autoimmunity was investigated by determining thyroid autoantibodies immediately prior to and 3 to 6 months after injection of iodinated contrast medium; and acute and chronic effects on thyroid function were investigated by performing thyroid function tests immediately prior to, 24 hours after and 3 to 6 months after injection of iodinateed contrast medium.

43824 (HEDL-SA—1502FP) **Practical radiation protection for radiography.** Hubbard, S.K.; Proudfoot, E.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 20 Mar 1978. Contract EY-76-C-14-2170. 30p. (CONF-780899—1). Dep. NTIS, PC A03/MF A01.

From Conference on radiation safety in NDT; San Francisco, CA, USA (1 Aug 1978).

Nondestructive Testing Applications and Radiological Engineering at the Hanford Engineering Development Laboratory have developed radiation protection procedures, radiation work procedures, and safe practice procedures to assure safe operation for all radiographic work. The following topics are discussed: training in radiation safety; radiation exposure due to operations at Hanford; safeguards employed in laboratory radiography; field radiographic operations; and problems. (HLW)

43825 (LBL—9018) **Health effects of low-level ionizing radiation.** Fabrikant, J.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

It is now assumed that any exposure to radiaton at low levels of dose carries some risk of deleterious effects. How low this level may be, or the probability or magnitude of the risk, still are not known. Our best scientific knowledge and advice are essential for the protection of the public health, for the effective application of new technologies in medicine and industry and for guidance in the production of nuclear energy. Unless man wishes to dispense with those activities which inevitably involve exposure to low levels of ionizing radiations, he must recognize that some degree of risk to health, however small, exists. A pragmatic appraisal of how man wishes to continue to derive the benefits of health and happiness from such activities involving ionizing radiaton in times of ever-changing conditions and public attitudes in our resource-limited society is the task which lies before all of us - all men and women of our society, of science and of medicine, and of law and government - now and in the future.

43826 (LBL—9084) **Effects on populations of exposure to low levels of ionizing radiation: implications for nuclear energy and medical radiation. The 1979 report of the Advisory Committee on the Biological Effects of Ionizing Radiation (The BEIR Report).** Fabrikant, J.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., San Francisco (USA)). Apr 1979. Contract W-7405-ENG-48. 46p. (CONF-790474—1). Dep. NTIS, PC A03/MF A01.

From Symposium on known effects of low level radiation exposures; Pittsburgh, PA, USA (25 Apr 1979).

The following aspects of the 1979 BEIR report are described: societal decision-making; nuclear energy needs and medical care services; epidemiological and experimental studies; public acceptance; concept of risks to health; risk estimates and cost-benefit analysis; and comparison of risks. Other topics discussed are as follows: need for advisory committees on radiation; value of the BEIR report; health effects of low levels of ionizing radiation; determination of radiation risk estimates; and quantitation of radioinduced cancer risk estimates. (HLW)

43827 (NUREG/CR—0426(Vol.2)) **Radiation dose to construction workers at operating nuclear power plant sites. Volume 2. Appendices A—F. Final report, September 1975—September 1978.** Endres, G.W.R.; Shipler, D.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1978. Contract EY-76-C-06-1830. 200p. (PNL—2773(Vol.2)). Dep. NTIS, PC A09/MF A01.

These appendices contain the dosimetry procedures and details of the personnel and environmental dosimeters used for the Radiation Dose to Construction Workers at Operating Nuclear Power Plant Sites Study. A printout of the computer codes used to analyze dosimeter data is included along with all the raw data obtained. Appendices C through F contain computer output and log-normal plots of dosimetry data for environmental location and construction worker groups.

43828 (PB—287346) **Report of state and local radiological health programs. Fiscal Year 1977. Annual report 1975-77.** Moats, R.A.; Miller, L.A. (Bureau of Radiological Health, Rockville, MD (USA)). Aug 1978. 53p. NTIS PC A04/MF A01.

This report is the seventeenth of a series based on data provided by 53 state and local radiological health programs. The resources and activities of state and local radiological programs are presented and summarized from data provided as of June 30, 1977. Summary data are included for Fiscal Years 1975 through 1977. Resources include data on personnel, funds, and equipment. The program activity areas are basic planning and administration, x-ray survey and control, environmental surveillance, radioactive materials, nonionizing radiation, and other radiological health activities.

43829 (PB—287356) **Diagnostic radiology quality assurance catalog - supplement.** Burkhart, R.L. (Bureau of Radiological Health, Rockville, MD (USA). Div. of Training and Medical Applications). Aug 1978. 262p. NTIS PC A12/MF A01.

This supplement updates the listing of quality assurance resources, first published as HEW Publication (FDA) 77-8028 (July 1977), available to facilities which perform diagnostic radiology. The information was compiled by the Bureau of Radiological Health in order to assist diagnostic radiology facilities in pursuing quality assurance programs; inclusion of an item does not constitute endorsements by the Food and Drug Administration. The Supplement has four sections: (1) test devices and services, (2) training courses and materials, (3) publications, and (4) combined indices for the Diagnostic Radiology Quality Assurance Catalog and its Supplement.

43830 **Can animal and in vitro studies give new, relevant answers to questions concerning mammographic screening for human breast cancer?.** Dethlefsen, L.A. (Univ. of Utah Medical Center, Salt Lake City); Brown, J.M.; Carrano, A.V.; Nandi, S. Contract W-7405-ENG-48. *J. Natl. Cancer Inst.;* **61**: No. 6, 1537-1545(Dec 1978).

First, we recommend that no further animal population carcinogenesis studies aimed at quantifying the risk per rad be initiated at this time. This strong recommendation is based on: (1) the fact that human breast radiation-carcinogenesis data already exist from several studies, and quantitative estimates of risk that can be made from these data are directly relevant to the mammography situtation; (2) the serious questions about the validity of direct extrapolation from the current rodent models that have the necessary base-line data already established; and (3) the difficulty and expense involved in conducting a large rodent experiment with fractionated low-dose protocols comparable to X-ray mammography. Second, in contrast to the animal population studies, we do recommend that the Breast Cancer Task Force seriously consider funding new studies to evaluate the cellular and molecular events relating to carcinogenesis. These specifically should be focused on the intriguing evidence suggesting that (1) the risk per rad may actually be higher at fractionated low doses than at higher doses, and (2) women at higher risk from other factors (e.g., age, genetic, hormonal) may actually be at a higher risk for X-irradiation carcinogenesis than are women at low risk to the other factors. The studies recommended above are obviously aimed at the basic mechanism of X-ray carcinogenesis and cocarcinogenesis, and the results would most likely have direct application to X-ray carcinogenesis in general as well as radiation-induced breast cancer per se.

VERTEBRATES

43831 (BNL—26107) **Hemopoietic stem cell niches, recovery from radiation and bone marrow transfusions.** Cronkite, E.P.; Carsten, A.L.; Brecher, G.; Feinendegen, L. (Brookhaven National Lab., Upton, NY (USA); California Univ., Berkeley (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790524—5). Dep. NTIS, PC A02/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

Studies were conducted on the appearance of cells in recipient bone marrow with chromosome markers after bone marrow transfusion to recipients that had different treatments. Investigators tried to replete the bone marrow CFV spleen at various times after recovery from maximal sublethal doses of x radiation or during continuous exposure to tritiated water. Studies were made on the effect of diverse treatments on the acceptance of bone marrow transfusions as shown by chromosomal markers. Results showed that the bone marrow of animals rescued by transfusion of 4 x 10^6 bone marrow cells will accept from 0 to 25% of the second transfusion of bone marrow cells given one to 4 months after the first transfusion and examined 2 to 3 weeks after the second transfusion. This may be due to the second transfusion filling up empty niches. (HLW)

43832 (PNL—2462) **American coot (Fulica americana) on the Hanford Site. Part 1. Nesting biology.** Fitzner, R.E.; Schreckhise, R.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1979. Contract EY-76-C-06-1830. 40p. Dep. NTIS, PC A03/MF A01.

The nesting biology of the American coot was studied on low-level radioactive waste ponds located on the Hanford DOE Site and on control ponds located in the Columbia National Wildlife Refuge in southeastern Washington from 1974 through 1976. The objective was to discover any differences in the nesting biology of the birds which could be attributed to the low-level radioactive wastes present in the Hanford DOE Site ponds. Coots nesting on the Hanford ponds and those nesting on the wildlife refuge were found to have similar nesting habits. Nesting habitats were also similar. There were no apparent differences in nesting chronology between birds from the different study sites. Clutch size also showed no significant differences. The average number of eggs per nest for all ponds was 6.7. Egg and chick weights and percent hatching success were similar among coots from both study sites. Feeding habits of the coots from the two sites did show some differences. However, this is probably related to the availability of food items in each pond.

43833 **Rat differences in mammary tumor induction with estrogen and neutron radiation.** Shellabarger, C.J.; Stone, J.P; Holtzman, S. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Natl. Cancer Inst.;* **61**: No. 6, 1505-1508(Dec 1978).

Young adult female rats of either the Sprague—Dawley stock or the ACI strain were each given an implant of a compressed pellet of 5 mg diethylstilbestrol (DES) and 15 mg cholesterol 2 days before irradiation with 0.4, 1.3, or 4.0 rads of 0.43-MeV neutrons. These rats were studied, along with appropriate irradiated and nonirradiated controls, until death or for a maximum of 48 weeks. Response differences between the strain and stock included the following: DES produced both pituitary tumors and mammary adenocarcinomas (MAC) only. Neutron radiation increased mammary fibroadenoma (MFA) formation in Sprague—Dawley rats only. No interactions between DES and radiation on MAC formation in Sprague—Dawley rats. However, when DES and neutron radiation were combined, DES appeared to inhibit the MFA response to radiation in Sprague—Dawley rats. In contrast, DES appeared to act synergistically with neutron radiation on MAC formation in ACI rats. These results clearly demonstrate rat differences in mammary gland carcinogenesis in response to estrogen, to radiation, or to a combination of both agents.

43834 (UCRL-Trans—11452) **Effect of whole-body irradiation with varied radiation doses on the quality of rabbit sperm.** Eston, V.R.; Eston, T.E.; Barnabe, R.C.; Rockmann, T.M.B.; Sato, M.K.; Sabia, A.L. Translated from *Cienc. Cult. (Sao Paulo);* **27**: No. 7, 546-547(1975). 2p. Dep. NTIS, PC A02/MF A01.

Pure-bred white New Zealand rabbits were irradiated with a 4 MeV linear accelerator, receiving single whole-body doses of either 50, 200, or 600 rads. Among the parameters analyzed was the quality of the sperm in a sample collected from each rabbit after 7 hrs, 3 days, 1, 2, 4, 8, and 12 weeks. The appearance, pH, mass movement, and percentile motility were analyzed, and a total count per mm^3 was taken and the DNA and RNA levels were measured. The data obtained demonstrate convincingly the effect of whole-body irradiation on the gonads. Rabbit impotence accompanies the state of debility of rabbits irradiated with 600 rads; they do not survive over 10 days. Even at 50 rads there was diminished mass movement and motility of spermatozoa in the samples taken after 3 days and 4 weeks, although their number did not decline. The DNA levels indicate a minimum of nucleated elements in the samples taken after 4 weeks and a maximum in the samples taken after 12 weeks. At 200 rads, the damage was more extensive, with low counts being found after 3 days and an absence of movement after 12 weeks, although the number of spermatozoa had not changed significantly. Most of the samples taken from rabbits receiving 600 rads showed no movement. Our data indicate that both the mature spermatozoa and their earlier stages, spermatids and spermatocytes, are actually damaged to the extent of losing motility even at doses of 50 rads.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 43758, 43764, 43786

43835 (COO—4326-1) **In vivo measurements of bone-seeking radionuclides. Progress report, September 1, 1977—February 28, 1979.** Cohen, N. (New York Univ., NY (USA). Medical Center). 1 Nov 1978. Contract EE-77-S-02-4326. 126p. Dep. NTIS, PC A07/MF A01.

From ES;

Progress is reported on the following research projects: estimation of the skeletal burden of bone-seeking radionuclides from in vivo scintillation measurements of their content in the skull; contribution from radionuclides in the thoracic skeleton to in vivo measurements of activity in the lung; design and optimization characterictics of in vivo detection system; development of a calibration phantom structure for determining activity deposited in the thoracic skeleton; computer assisted in vivo measurements of internally deposited radionuclides using dual-crystal scintillation detectors; low energy, photon-emitting nuclides; reference spectra library; and in vivo measurements of exposed individuals. (HLW)

43836 (DPSPU—79-30-1) **Environmental monitoring in the vicinity of the Savannah River Plant. Annual report for 1978.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA)). 1979. Contract EY-76-C-09-0001. 71p. Dep. NTIS, PC A04/MF A01.

The radiation dose at the plant perimeter or the population dose in the region from SRP operations is very small relative to the dose received from naturally occurring radiation. The annual average dose in 1978 from atmospheric releases of radioactive materials from SRP was 0.76 millirem (mrem) at the plant perimeter (approximately 1% of natural background). The maximum dose at the plant perimeter was 1.05 mrems, which is 0.2% of the Department of Energy limit for offsite exposures. The total radiation exposure at the plant perimeter from SRP releases and natural background radiation (98 mrems) was substantially less than the exposure of a person living in Columbia, SC (111 mrems), or Atlanta, GA (124 mrems). These differences are due to variation in natural radiation. The population dose to people living within 80 km (50 mi) of the center of SRP (population: 465,000) was 110 man-rems. During 1978, this same population received a radiation dose of 54,400 man-rems from natural radiation and an additional dose of 47,000 man-rems from medical x rays. An individual consuming river water downstream from SRP would receive a maximum calculated dose of 0.32 mrem. Air and water are the major dispersal media for radioactive emissions. Samples representing most segments of the environment that may conceivably be affected by these emissions were monitored to ensure a safe environment. Releases of radioactivity from SRP had very small effect on living plants and animals and were too minute to be detectable, and with a few exceptions, concentrations outside the plant boundary were too low to distinguish from the natural radioactive background and continuing worldwide fallout from nuclear weapons tests.

43837 (PNL—2833) **Environmental consequences of postulated plutonium releases from the Babcock and Wilcox Plant, Leechburg, Pennsylvania, as a result of severe natural phenomena.** McPherson, R.B.; Watson, E.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 61p. Dep. NTIS, PC A04/MF A01.

Potential environmental consequences in terms of radiation dose to people are presented for postulated plutonium releases accidently caused by severe natural phenomena at the Babcock and Wilcox plant, Leechburg, Pennsylvania. The severe natural phenomena considered are earthquakes, tornadoes, high straight-line winds, and floods. Maximum plutonium deposition values are given for significant locations around the site. All important potential exposure pathways are examined. The most likely 50-year committed dose equivalents are given for the maximum-exposed individual and the population within a 50-mile radius of the plant. The maximum plutonium deposition values most likely to occur at the site boundary are also given. The most likely calculated 50-year collective committed dose equivalents are all much lower than the collective dose equivalent expected from 50 years of exposure to natural back-

ground radiation and medical x-rays. The most likely maximum residual plutonium contamination estimated to be deposited at the site boundary following Earthquake No. 3, the 110-mph and 130-mph winds, and the 130 mph tornado are above the Environmental Protection Agency's (EPA) proposed guideline for plutonium in the general environment of 0.2 $\mu Ci/m^2$.

43838 (PNL—2932) **Environmental surveillance at Hanford for CY-1978.** Houston, J.R.; Blumer, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 63p. Dep. NTIS, PC A04/MF A01.

Hanford operations during 1978 caused no distinguishable impact on concentrations of airborne radionuclides or on external radiation dose measured near to and far from the Hanford Site. Maximum concentrations of airborne radionuclides were observed following the March 15, 1978 atmospheric nuclear test by the People's Republic of China. Concentrations of ^{131}I as high as 8 pCi/l were observed in milk samples following the Chinese nuclear test in March. The maximum hypothetical dose to an infant thyroid from consumption of milk at the observed levels was about 1 mrem. Radionuclides observed in foodstuffs, wildlife, and soil samples were all attributed to either worldwide fallout or natural sources. External dosimeter measurements along the Columbia River islands and shoreline near the Hanford Site showed elevated doses attributed to the presence of a few long-lived radionuclides, principally ^{60}Co, from past operation of once-through-cooled production reactors. Low-level concentrations of a few radionuclides released to the Columbia River from N Reactor during 1978 were observed at the downstream sampling location. The maximum annual whole-body dose to an individual from 1978 effluents was estimated to be less than 0.1 mrem. Airborne effluents from the Hanford Site's three operating areas resulted in an annual whole-body dose to the population within an 80-km (50-mile) radius of Hanford of about 1.5 person-rem.

ANIMALS

REFER ALSO TO CITATION(S) 43761, 43774, 43775, 43813

PLANTS

REFER ALSO TO CITATION(S) 43757, 43761, 43775

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 42665

VERTEBRATES

REFER ALSO TO CITATION(S) 42961

43839 **Hudson River power case: Oak Ridge scientists play a role.** Krause, C. *Oak Ridge Natl. Lab. Rev.;* **12**: No. 1, 26-34(Win 1979).

Issues involved in the Hudson River Power Case are reviewed, and the role of Oak Ridge National Laboratory (ORNL) ecologists in helping to resolve the issues is summarized. Of prime concern is the effect of the proposed pumped-storage hydroelectric plant near Cornwall on the Hudson River on the traditional habitat for the Atlantic Ocean striped bass. Positions drawn by the utility involved and the Environmental Protection Agency are outlined. (JGB)

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 42665, 43729

43840 (EPRI-EA—1072) **Chemical effects of power plant cooling waters: an annotated bibliography.** Opresko, D.M.; Hannon, E.H. (Oak Ridge National Lab., TN (USA); Atomic Industrial Forum, Inc., Washington, DC (USA)). May 1979. 394p. Dep. NTIS, PC A17/MF A01.

Presented in the format of an annotated bibliography are 950 references dealing with the environmental impact of chemical discharges associated with power plant cooling systems. The references were extracted from the open literature for the period up to the fall of 1977 and from environmental reports and impact statements prepared for or by the electric utility industry. The topics covered pertain to currently used and potential biofouling control methods (chemical, thermal, mechanical); environmental effects of metals, corrosion inhibitors, and special use compounds released in cooling waters; and site-specific effects of chemical discharges on water quality and aquatic communities. The references are arranged by subject category, and indexes are provided to authors' names, keywords, scientific names of test organisms, geographic location of field research, and AIF accession numbers.

CELLS

REFER ALSO TO CITATION(S) 43821

43841 **Involvement of DNA damage in hydroxyurea-mediated induction of endogenous murine retrovirus.** Rascati, R.J.; Tennant, R.W. (Oak Ridge National Lab., TN). *Virology;* **94**: No. 2, 273-281(30 Apr 1979).

Hydroxyurea (HU) induces AKR cells to produce endogenous murine retrovirus at a low frequency ($\sim 1 \times 10^{-5}$), and DNA synthesis is required soon after treatment with HU for induction to be observed (i.e., no stable induction intermediate is formed). Induction by HU can be enhanced by simultaneous treatment with halogenated pyrimidines, with the concomitant appearance of a stable induction intermediate state. The effects of the two compounds are synergistic, indicating an actual stimulation of HU-mediated induction by iodode-oxyuridine. Since HU inhibits semiconservative replication, and since [^{3}H]bromodeoxyuridine is incorporated into the cellular genome predominantly by unscheduled DNA synthesis (repair replication) under these conditions, this stimulation appears to be the result of insertion into DNA of the thymidine analogs during the repair of HU-induced alterations in the DNA. The nature of HU damage to DNA is not defined; if single-strand breaks are involved, they may occur at a frequency $< 10^{-6}$ and escape detection, but induction could also be due to other alterations in DNA. The characteristics of induction by HU, therefore, are similar to those of induction by other DNA-damaging treatments such as γ or x irradiation or methylcholanthrene. This suggests that these agents may induce by similar, if not identical, mechanisms. Further, the ability of halogenated pyrimidines to form a stable induction intermediate when incorporated by repair synthesis, similar to the intermediate formed when the analogs are incorporated during semiconservative replication, suggests that the same sites are involved for induction by damaging agents or by halogenated pyrimidine incorporation.

43842 **Mutagenesis and cell transformation of mammalian cells in culture by chemical carcinogens.** Huberman, E. (Oak Ridge National Lab., TN). *J. Environ. Pathol. Toxicol.;* **2**: 29-42(1978).

In the process of in vitro cell transformation, normal cells, which have an oriented pattern of growth and a limited life span in vitro and which are not tumorigenic, are converted into cells that have a hereditary random pattern of growth, the ability to grow continuously in culture, and the ability to form tumors. Such heritable phenotypic changes may arise from alterations in gene expression due to somatic mutations after interaction of the carcinogen with cellular DNA. Our studies have indeed shown (a) that metabolically activated carcinogenic polycyclic hydrocarbons which have been shown to bind to cellular DNA induce somatic mutations in mammalian cells; (b) that there is a relationship between the degree of mutant induction and the degree of carcinogenicity of the different hydrocarbons tested; and (c) that the somatic mutations were induced by metabolites rather than by the hydrocarbons themselves. In the case of benzo(a)pyrene (BP), a very common carcinogenic polycyclic hydrocarbon, its 7,8-diol-9,10-oxide was identified as the major mutagenic and cell-transforming metabolite. Based on these studies, it was possible to estimate the genetic target size for cell transformation by comparing in the same cells the frequency of cell transformation and mutation for ouabian resistance (which is presumably due to a mutation at one locus) induced by BP and by one of its major metabolites. The results indicated that the target size for transformation is 20 times larger than that determined for ouabain resistance. This suggests that cell transformation, as determined by a hereditary pattern of cell growth, may be due to a mutation and that this mutation can occur in one out of a small number of the same or different genes.

MICROORGANISMS

REFER ALSO TO CITATION(S) 43777, 43841

43843 (UCID—18174-79-1) **Mutagens from the cooking of food. Semiannual progress report, 1 October 1978—1 March 1979.** Mendelsohn, M.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1979. Contract W-7405-ENG-48. 55p. Dep. NTIS, PC A04/MF A01.

The objectives of this project are to: (a) determine the nature and mechanism of formation of the putative mutagens formed during the cooking of foods, (b) to assess the spectrum of genetic toxicity caused by the mutagens in a bacterial test and in both in vitro and in vivo short-term mammalian bioassays, (c) to estimate the risk to the population posed by ingestion of mutagens in the diet, and (d) to devise strategies for control or prevention of mutagen formation. In

the first six months we have confirmed the reports that bacterial mutagens are formed in the cooking of well done but non-charred hamburger at 200°C. The mutagens were active only after metabolic activation with Aroclor 1254-induced microsomal fraction (S9) from rat liver. Mutations were induced only in Salmonella strains sensitive to agents causing frameshift mutations and not in those sensitive to agents causing missense mutations. The chemical properties and mutagenic behavior of the agents are compatible with their being heterocyclic aromatic amines. It is unproven that the mutagens produced during cooking of foods survive the digestive process and inflict genetic injury on the cells of the intestine or other organs. However, a related chemical, 2-acetylaminofluorene (2-AAF), is a potent liver carcinogen when fed to rats.

PLANTS

REFER ALSO TO CITATION(S) 42307

43844 (UCRL-Trans—11451) **Influence of low SO_2 concentrations on CO_2 uptake of spruce and fir.** Keller, T. Translated from *Photosynthetica;* **12**: No. 3, 316-322(1978). 17p. Dep. NTIS, PC A02/MF A01.

Grafts of fir (Abies alba) and spruce (Picea excelsa) were subjected to a 10 week constant fumigation with 0.05, 0.1 and 0.2 $\mu l l^{-1}$ (ppM) SO_2, respectively, at three different stages of needle development. CO_2 uptake was measured periodically with an infrared gas analyzer. CO_2 uptake decreased with increasing concentration and duration of exposure. Concentrations of 0.05 ppM SO_2 did not cause visible symptoms of injury. A stimulation of photosynthesis was not detected in any case.

INVERTEBRATES

REFER ALSO TO CITATION(S) 43738

43845 (COO—3474-4) **Cycling and effects of ^{36}Cl labeled DDT on soil invertebrates.** Dindal, D.L. (State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry). Aug 1978. Contract EY-76-S-02-3474. 24p. Dep. NTIS, PC A02/MF A01.

DDT, radiolabeled with ^{36}Cl (total activity of 10.2 mc) and applied in the field at the rate of 1.12 kg/ha, cannot be detected within decomposer microarthropods using liquid scintillation spectrometry. Soil microarthropods exhibit both positive and negative responses to direct and indirect effects of DDT. Faunal simplification (decreased diversity) resulting from pesticide application as reported by many others does not apply to the oribatid and prostigmatid mites of the old field. New colonization is possible by some species of Acari as a result of DDT application. Soil microbial respiration is enhanced by a single DDT application of 1 kg/ha. No apparent relationships exist between the increased microbial respiration and soil microarthropod population dynamics in this DDT treated old field. No apparent relationships exist between soil pH, moisture levels, texture and soil microarthropod population dynamics. Microarthropod community structure (species diversity and richness, interspecific relationships and similarity) are definitely affected by a single application of DDT. The Prostigmata are the most numerous mites in the soil of an old field in central Ohio. Vertebrate predators feeding on terrestrial snails may be subjected to magnified concentrations of DDT residues. Coprophagic decomposer organisms feeding on snail feces will be subject to much larger DDT concentrations. Terrestrial snails represented by Cepaea and Otala are not killed by acute oral doses of DDT. Within a three year period after a single application of DDT no effects on the soil faunal populations were seen below 3 cm of soil.

VERTEBRATES

43846 (NUREG/CR—0748) **Copper sensitivity of the Northern anchovy, Engraulis mordax, during its early life history.** Rice, D.W. Jr.; Harrison, F.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1978. Contract W-7405-ENG-48. 37p. (UCRL—52499). Dep. NTIS, PC A03/MF A01.

The sensitivity to copper of embryonic and larval stages of the Northern anchovy, Engraulis mordax, was determined using a flow-through bioassay system. Anchovy embryos were exposed continuously from 8 to 10 h after fertilization until hatching, and the larvae were exposed within 24 h after hatching until yolk-sac absorption. During the testing, both total copper concentrations and the percent copper in labile forms were determined. From the cumulative mortality vs measured copper exposure data, a series of median lethal concentrations (LC_{50}) were determined. These LC_{50} values were used to construct comparative toxicity curves. The anchovy life stage most sensitive to copper was the embryonic stage. For the anchovy embryo, the 12-h LC_{50} was 200 μg Cu/l, and the estimated incipient lethal concentration (ILC_{50}) was 190 μg Cu/l; a sensitive period of embryonic development was noted prior to closure of the blastopore. The 12-h, 24-h, and ILC_{50} for anchovy larvae were 460, 400, and 370 μg Cu/l, respectively.

43847 (UR—3490-1539) **Metal binding by intestinal mucus.** Coleman, J.R.; Young, L.B. (Rochester Univ., NY (USA). School of Medicine and Dentistry). 1978. Contract EY-76-C-02-3490. 15p. (CONF-790418—5). Dep. NTIS, PC A02/MF A01.

From Scanning electron microscopy conference; Washington, DC, USA (16 Apr 1979).

Portions of document are illegible.

The study of mucus has been hampered by the fact that it is heterogeneous, consisting of a protein core associated with highly variable branched chain sugar residues. This heterogeneity introduces ambiguities that have made isolation of mucus difficult. Electron probe microanalysis offers distinct advantages for the study of intestinal mucus. This technique permits analysis of metal binding in situ, requires only a small amount of tissue, allows several experiments to be performed with one animal, and can resolve variations in binding that may occur in different portions of the intestine. We have used electron probe microanalysis to examine the metal binding capacity of intestinal mucus in situ. We have exposed portions of excised intestine to various concentrations of several metals, rapidly frozen the tissue and freeze dried it. After anhydrous embedding, thick sections were cut and analyzed on silicon discs. Qualitative analysis shows three distinctive patterns of distribution. The results of this work show clearly that several metals are bound by mucus, the influence of mucus must be considered in short term measurements of metal uptake, that mucus exhibits different affinities for different metals, and the binding of metals is not uniform throughout mucus.

MAN

REFER ALSO TO CITATION(S) 43843

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 43828

43848 (EPRI-EA—1020) **Feasibility of an epidemiological study of workers occupationally exposed to high voltage electric fields in the electric power industry.** Utidjian, H.M.D. (Equitable Environmental Health, Inc., Rockville, MD (USA)). Mar 1979. 31p. Dep. NTIS, PC A03/MF A01.

This feasibility study was conducted for the Electric Power Research Institute to investigate the practicality of an epidemiological study on workers occupationally exposed to high voltage electric fields. Identification of a target population to be studied, examination of the various epidemiologic methods which could be undertaken, and cost estimates were the objectives for this study. As an initial step to address these issues, a sample questionnaire was sent to several utility companies. Tentative recommendations regarding possible approaches and specific cost estimtes and time projections have been stated.

43849 (PNL—2634(Rev.)) **Compilation and assessment of microwave bioeffects. Final report. A selective review of the literature on biological effects of microwaves in relation to the Satellite Power System (SPS).** Justesen, D.R.; Ragan, H.A.; Rogers, L.E.; Guy, A.W.; Hjeresen, D.L.; Hinds, W.T.; Phillips, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 100p. Dep. NTIS, PC A05/MF A01.

One of many alternate sources of electrical energy that are being considered by the Department of Energy is a microwave-mediated Satellite Power System (SPS). Once inserted into geosynchronous orbit at an altitude of more than 40,000 kilometers, a satellite would collect then convert the sun's energy to 2450-MHz microwaves, which would be beamed to the Earth's surface, where a rectifying antenna (rectenna) would convert the microwaves to electrical current suitable for industrial and domestic use. The expanse of each rectenna (about 10 by 13 kilometers), the power density of the continuous-wave microwave beam (~ 23 mW/cm^2 at center, with fall off to 1 mW/cm^2 or less at the periphery of the rectenna), and the possibility that 20 or more satellite systems will eventually be operating, creates two sets of interrelated problems for biological/ecological assessment. These are 1) the effects of microwave fields of higher intensity on airborne biota (including human beings in aircraft) that may traffic the area above the rectenna and 2) the effects of virtually perpetual fields of much lower intensity on all forms of life at and beyond the rectennae's zone of exclusion. In this review, the scientific literature is examined, not only for biological effects that are pertinent to assessment of SPS, but for hiatuses of

knowledge that will have to be filled before SPS can be vouched for operational safety.

43850 (SAND—79-0465C) **Long range blast predictions and measurements, Misers Bluff, Phase II.** Reed, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 41p. (CONF-790349—1). Dep. NTIS, PC A03/MF A01.

From DNA misers bluff symposium; Albuquerque, NM, USA (27 Mar 1979).

Both Event 1 (120 ton ANFO) and Event 2 (720 ton ANFO) explosions had the potential for causing nuisance airblast damage at long range (50 km) with atmospheric propagation enhancement. A Weather Watch blast prediction service, and microbarograph measurement project was established to help avoid generating any significant off-site disturbance. The system worked quite well, airblast waves were propagated beyond Planet Ranch.

43851 (UCRL—50007-78-1) **Hazards control progress report No. 56, January—September 1978.** Griffith, R.V. (ed.). (Royal Research Corp., Hayward, CA (USA)). 29 Jan 1979. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

Progress is reported on fire safety with regard to HEPA filter fire protection; fire protection research for fusion energy experiments; evaluation of the fire endurance of boron-loaded liners for waste disposal and storage containers; the feasibility of using sonic nozzles as a countermeasure for incipient cable insulation fires; flammability tests on fabrics used in firemen's uniforms using the standard for children's sleepwear; fire resistance of HEPA filters in glove-box systems. Progress on instrument development is reported with regard to: Trax-II, a new generation of monoenergetic transmission anode x-ray tubes and an automated flow-temperature-humidity control system. (HLW)

43852 (UCRL—81757) **Noise-abatement method for explosives testing.** Pfeifer, H.E.; Odell, B.N.; Arganbright, V.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Apr 1979. Contract W-7405-ENG-48. 19p. (CONF-790633—1). Dep. NTIS, PC A02/MF A01.

From American industrial hygiene conference; Chicago, IL, USA (1 Jun 1979).

When Lawrence Livermore Laboratory started detonating explosives at its Site 300 test location, residents in neighboring areas complained of sudden loud noises. A combined literature and research study, coupled with an experimental test program, indicated that the combination of air temperatures and winds at various elevations was primarily responsible for blast or sound waves being returned to the surface. To solve the noise problem, the Laboratory devised a method for determining the maximum amount of explosives that could be detonated aboveground under various atmospheric conditions without creating excessive noise in populated areas. This method for predicting explosives weight limits using pressure—distance—weight nomograms and the slope of a sound—velocity curve is described. The sound—velocity curve is computed with temperature information from the U.S. Weather Bureau and wind data from a target-acquisition radar system. By following this method, the Laboratory has been able to detonate thousands of shots without creating excessive noise in nearby communities.

43853 (UR—3490-1561) **Metabolic and physical scaling in microwave/radiofrequency bioeffects studies.** Michaelson, S.M.; Lu, S.T. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 4p. (CONF-790627—3). Dep. NTIS, PC A02/MF A01.

From Bioelectromagnetics symposium; Seattle, WA, USA (18 Jun 1979).

Research on the biological effects of microwaves is primarily related to the problem of hazard assessment for exposure of man. To reach an objective, scientifically valid solution to the hazard assessment problem, two complex, integrative tasks must be systematically accomplished. One of these is the determination of the absorbed energy required to cause deleterious changes in body functions of experimental animals; this requires a quantitative evaluation and comparison of the many experiments that have been conducted. The second task is extrapolation of the results of animal experiments to the exposure conditions of man. Data obtained on dogs, rabbits, and rats exposed to 2880 MHz and 1280 MHz, Pulsed and 200 MHz CW have been reevaluated in the light of more recent concepts related to Specific Absorption Rates (SAR). These results will be integrated with recently published data for 2450 MHz CW exposure of rats and non-human primates to provide a basis for establishing extrapolation factors for human exposure.

HEALTH AND SAFETY

43854 (Y—2178) **Evaluation of wash bottles for flammable solvent use.** Schmitt, C.R.; Whitehead, H.D.; White, J.E. (Oak Ridge Y-12 Plant, TN (USA)). 15 May 1979. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

Polyethylene wash bottles for flammable solvents were recently approved by the Department of Energy (DOE) for use at the Oak Ridge Y-12 Plant with the restriction that pressure relief must be provided. A laboratory study was made of vent holes of various diameters located in the caps and dispensing tube of wash bottles containing a wide variety of flammable and nonflammable solvents. Wash bottles vented with a 0.63-mm hole in the dispensing tube were found to be optimum for the needed pressure relief.

43855 **Need for greater inter-agency cooperation, and controlling risks associated with non-nuclear systems.** Clifford, P.R. (Mitre Corp., McLean, VA). pp XI.4.1-XI.4.5 of Probabilistic analysis of nuclear reactor safety. La Grange Park, IL; American Nuclear Society, Inc. (1978).

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

The need for increased cooperation among the federal agencies in the non-nuclear energy field to ensure the safety of workers and the public is briefly discussed. Precedents for interagency cooperation are being established in the field of control of toxic substances. These precedents should be followed in regulating non-nuclear energy systems.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 42350, 42367, 42428

43856 (RHO-BWI-ST—1) **Geophysical logging and hydrologic testing of deep basalt flows in the Rattlesnake Hills Well Number One.** Gephart, R.E.; Eddy, P.A.; Deju, R.A. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jan 1979. Contract EY-77-C-06-1030. 136p. Dep. NTIS, PC A07/MF A01.

Geophysical logging and hydrologic testing were conducted in the Rattlesnake Hills Well Number One located along the western boundary of the Hanford Site in south-central Washington. Three-dimensional velocity, Seisviewer and caliper logging were completed across 2,000 feet of basalt rock within the Wanapum and Grande Ronde formations. Drillstem testing focused along a 250-foot interval of the Grande Ronde Formation. Individual high- (~ 2.7-2.9 grams per cubic centimeter) and low-density (~ 2.3-2.6 grams per cubic centimeter) basalt zones within the Wanapum Formation are generally less than 50 feet thick. Within the estimated thickness of the Grande Ronde Formation, 85 percent of the low-density zones are less than 50 feet thick, compared to 55 percent of those of higher density. The Grande Ronde Formation has 13 high-density zones varying in thickness from 51 to 230 feet. Logging data suggest the thicknesses of low-density are independent of the thicknesses of the associated and underlying higher density columnar basalts. Eleven drillstem tests were conducted across selected intervals within the Grande Ronde Formation. Hydraulic conductivity values calculated for the low-density basalt zones ranged between 1.7×10^{-7} and 3.8×10^{-9} centimeters per second; those for high-density zones were between 1.1×10^{-8} and 4.7×10^{-9} centimeters per second.

43857 (UCRL—82609) **Permeability of generic repository rocks at simulated in situ conditions.** Heard, H.C.; Trimmer, D.; Duba, A.; Bonner, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Apr 1979. Contract W-7405-ENG-48. 14p. (CONF-790320—3). Dep. NTIS, PC A02/MF A01.

From Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks; Paris, France (19 Mar 1979).

New laboratory data are reported on the effect of confining (lithostatic) pressure, pore-water pressure, and principal stress difference on permeability of Westerly granite and White Lake gneissic granite. Permeabilities as low as 10^{-19} cm^2 (10^{-11} D) have been measured successfully, using a transient technique. Principal strains, electrical conductivity, and compressional velocity are determined simultaneously. Applied loads on the 15-cm diameter by 28-cm long test sample are controlled automatically and all data are taken by a microcomputer. Results on the gneissic granite indicate permeabilities of 10^{-18} to 10^{-19} cm^2 that appear to be unaffected either by effective pressure or by stress. The granite yields permeabilities of 4×10^{-16} cm^2 that decrease by a factor of two with pressure and vary

by a factor of two with stress. When compared to the initial value, compressional velocities increase by 4% and conductivity decreases by 50% as pressure is increased to 50 MPa in the gneissic granite. In granite, these become 3% and 58%, respectively. At pressure, loading of the granite of 0.5 of failure stress increases conductivity by about 20%.

43858 (USGS—474-262) **Map of the tuff aquitard (lower tuff units) in Yucca Flat, Nevada Test Site.** Fernald, A.T. (Geological Survey, Denver, CO (USA)). Feb 1979. Contract EY-76-A-08-0474. 36p. (NTS—263). Dep. NTIS, PC A03/MF A01.

The tuff units of Yucca Flat, Tertiary in age, have been divided into an upper aquifer and a lower aquitard. The tuff aquitard comprises all the tuffs and associated sedimentary rocks older than the Paintbrush Tuff. The aquitard formations consist of nonwelded to densely welded ash-flow tuff, ash-fall tuff, and reworked ash-fall and tuffaceous sandstone, siltstone, and claystone. One common feature among these formations is matrices consisting of zeolite or clay minerals. The tuff aquitard overlies two carbonate aquifers and two clastic aquitards of Precambrian and Paleozoic ages.

43859 **Numerical model for saturated-unsaturated flow in deformable porous media--3. applications.** Narasimhan, T.N.; Witherspoon, P.A. (Univ of Calif, Lawrence Berkeley Lab). *Water Resour. Res.;* **14**: No. 6, 1017-1034(Dec 1978).

The paper describes the application of a numerical model for saturated-unsaturated flow in deformable porous media. In all, 10 illustrative examples are presented to demonstrate the validity of the method and also to highlight the fundamental unity that exists in the basic principles of the fields of hydrogeology, soil mechanics, and soil physics. The chosen examples involve such diverse phenomena as soil consolidation, infiltration, and drainage and generation of fluid pressures due to cyclic loading such as earthquakes.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

43860 (COO—2708T003-2) **Global earthquake monitoring: its uses, potentials, and support requirements.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 1977. Contract EY-76-C-02-2708-003. 82p. Dep. NTIS, PC A05/MF A01.

The state of seismograph networks and arrays is summarized and evaluated in the light of current and foreseeable needs of the users of seismological data. Recommendations are made to responsible government decision makers and public officials. 16 figures. (RWR)

43861 (COO—2708T003-3) **Trends and opportunities in seismology.** (National Academy of Sciences, Washington, DC (USA)). 1977. Contract EY-76-C-02-2708-003. 166p. (CONF-760175—). Dep. NTIS, PC A08/MF A01.

From Trends and opportunities in seismology workshop; Pacific Grove, CA, USA (3 Jan 1976).

Thirty-five experts in the fields of geology, geophysics, and engineering, from academia, government, and industry, were invited to participate in a workshop and address the many problems of national and global concern that require seismological expertise for their solutions. This report reviews the history, accomplishments, and status of seismology; assesses changing trends in seismological research and applications; and recommends future directions in the light of these changes and of the growing needs of society in areas in which seismology can make significant contributions. The first part of the volume discusses areas of opportunity (understanding earthquakes and reducing their hazards; exploration, energy, and resources; understanding the earth and planets) and realizing the benefits (the roles of Federal, state, and local governments, industry, and universities). The second part, Background and Progress, briefly considers each of the following topics: the birth and early growth of seismology, nuclear test monitoring and its scientific ramifications, instrumentation and data processing, geodynamics and plate tectonics, theoretical seismology, structure and composition of the earth, exploration seismology, seismic exploration for minerals, earthquake source mechanism studies, engineering seismology, strong ground motion and related earthquake hazards, volcanoes, tsunamis, planetary seismology, and international aspects of seismology. 26 figures. (RWR)

VOLCANOLOGY

REFER ALSO TO CITATION(S) 43769

GEOPHYSICAL SURVEY METHODS

43862 (LA-UR—79-1053) **Spectral gamma-ray logging II: borehole correction factors.** Wilson, R.D.; Stromswold, D.C.; Evans, M.L.; Jain, M.; Close, D.A. (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 25p. (CONF-790605—5). Dep. NTIS, PC A02/MF A01.

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Experimentally determined factors are presented that correct spectral gamma-ray logs for the effects of varying borehole fluid and casing attenuation. These corrections are for gamma-ray spectra from the naturally radioactive isotopes of K, U, and Th. A sodium iodide spectral gamma-ray probe was used to collect data on the 1.46-MeV gamma ray from ^{40}K, the 1.76-MeV gamma ray from ^{214}Bi (a decay product of ^{238}U), and the 2.61-MeV gamma ray from ^{208}Tl (a decay product of ^{232}Th). Count rates for these gamma rays were measured for various borehole fluid and casing conditions. Borehole fluid corrections are presented for both centralized and sidewalled probe geometries for hole diameters from 3 to 12 inches. For a typical hole diameter of 4.5 inches and a probe diameter of 2.0 inches, the water correction is 23 percent for the potassium signal, and 15 percent for the uranium and thorium signals. For the smaller borehole diameters, the water correction is nearly independent of probe placement. As the borehole diameter increases to 12 inches, the correction for the uranium and thorium signals increases to 50 percent for the sidewalled geometry and to 100 percent for the centralized geometry. Gamma-ray transport calculations were performed to predict the effects of borehole water for the centralized probe geometry, and the resulting water factor corrections are somewhat lower than the measured values. The difference is attributed to the fact that detector response has not yet been included in the calculations. Casing corrections are presented for dry boreholes with thicknesses of steel casing from 1/16 inch to 1/2 inch. The data are fit reasonably well with exponential curves having effective linear attenuation coefficients of 1.26 $inch^{-1}$ for U and 1.03 $inch^{-1}$ for Th. 12 figures, 9 tables.

43863 (LA-UR—79-1054) **Spectral gamma-ray logging III: formation and thin bed effects.** Wilson, R.D.; Stromswold, D.C.; Evans, M.L.; Jain, M.; Close, D.A. (Bendix Field Engineering Corp., Grand Junction, CO (USA); Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 23p. (CONF-790605—4). Dep. NTIS, PC A02/MF A01.

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The effect of borehole formation parameters on spectral gamma-ray probe response was calculated from radiation theory. Results are presented for the effect of formation bulk density and composition on the gamma-ray spectra from potassium, uranium, and thorium. Experimentally determined response functions are presented for spectral gamma-ray probes logging through thin horizontal beds of potassium, uranium, and thorium. Potassium and thorium thin-bed results were obtained by numerical differentiation of the probe response across the interface between a thick zone containing potassium or thorium and a thick barren zone. Uranium results were obtained both from differentiation of thick zone interface measurements and directly using thin bed uranium models. Measurements were performed by use of sodium iodide detectors of various sizes. Detector size and shape were found to have a larger effect on the thin-bed response function than did the formation parameters, which can affect the transport properties of the gamma rays. Results were used to deconvolve observed borehole logs and obtain concentration with depth for thin ore zones. 10 figures, 1 table.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 43819, 43859

43864 (LBL—8280) **Preliminary report on geophysical and mechanical borehole measurements at Stripa.** Nelson, P.; Paulsson, B.; Rachiele, R.; Andersson, L.; Schrauf, T.; Hustrulid, W.; Duran, O.; Magnusson, K.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Terra Tek, Inc., Salt Lake City, UT (USA); Sveriges Geologiska Undersoekning, Stockholm). May 1979. Contract W-7405-ENG-48. 167p. (SAC—16). Dep. NTIS, PC A08/MF A01.

A suite of seven logs--neutron, gamma—gamma, resistivity, gamma ray, sonic, caliper, and temperature--operated in a borehole of 380-m depth located eleven zones where the rock permeability is expected to be enhanced due to the presence of open fractures. The sonic waveform record proved especially useful in this regard. Borehole measurements were also acquired in a large number of boreholes from 5- to 14-m length located in experimental drifts some

340-m underground. Here several physical properties, including the porosity, density, sonic velocity, and borehole rugosity, are generally quite uniform, with the exception of a few local chloritic zones and a few minor fractures. However, in situ determinations of the mechanical modulus with the CSM cell indicate substantial variability, with some apparent fracture control. Uranium and thorium concentrations are quite high in the Stripa granite, with local fluctuations associated with mineralogical changes as revealed by the gamma-ray log. A differential resistance probe appears promising as a sensitive detector of fine fracturing. A cross-hole ultrasonic system indicates variations of a few percent in compressional- and shear-wave velocities, reflecting the presence of fractures and changes in fracture characteristics as the rock is heated in a simulated storage test. The geophysical and mechanical data are being compared with the results from core and television logging, with hydrological test data on static pressure and injection permeability, and with displacements induced by thermal loading.

43865 (SAND—78-1841C) **Enhancement of geophysical soil profiles using instrumented marine sediment penetrators.** McNeill, R.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 21p. (CONF-790444—1). Dep. NTIS, PC A02/MF A01.

From Offshore technology conference; Houston, TX, USA (30 Apr 1979).

Static and dynamic penetrators measure strengths and layer thicknesses in soils of all strengths, to great depths in soft to medium soils. Thus, penetrators furnish information, quickly and cheaply, to allow geophysical travel-time profiles to include strengths and layer thicknesses. Case histories indicate that penetrators sense a soil strength between the maximum and the remolded, with about the same scatter as a conventional boring/sampling/testing program. Penetrator data are, however, obtained more quickly and probably more cheaply. For gas-charged soils, penetrator strength data may be the more reliable. Penetrators can also measure pore pressures and shaft friction in situ. The implantation and data analysis techniques, along with the instrument systems, are well developed. What needs to be done now is for the practicing professionals, geophysical and geotechnical, to evaluate penetrators for commercial use. 13 figures.

43866 (SAND—79-0137) **Constitutive models applied in the analysis of creep of rock salt.** Dawson, P.R. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MF A01.

constitutive equations for the creep of rock salt that have been utilized in the analyses of salt deformations are summarized. Primary creep, secondary creep, and elastoviscoplastic models are discussed. The strains predicted by several of the primary creep constitutive models are compared for identical conditions of deviatoric stress and temperature. Steady-state creep rates are compared under identical conditions of deviatoric stress and temperature for the secondary creep equations. 4 tables.

43867 (SAND—79-0853) **Loading technique for dynamic response studies of geological materials.** Butler, R.I.; Forrestal, M.J. (Sandia Labs., Albuquerque, NM (USA)). Apr 1979. Contract EY-76-C-04-0789. 17p. Dep. NTIS, PC A02/MF A01.

A loading technique to study the dynamic response of tuff was explored. Loading is provided by electrically exploding etched copper mesh patterns with current from a capacitor discharge. Pressure pulses with peak pressures up to 1.25 kbar and 0.10 to 0.20 ms durations were measured with a pressure bar. The upper value of peak pressure was limited by the strength of the experimental apparatus, and higher pressure generation is possible with a redesign of test hardware. 6 figures, 2 tables.

43868 (Y/OWI/SUB—78/22303/13) **Quasi-static strength and creep deformational characteristics of bedded salt from the Carey mine near Lyons, Kansas.** Hansen, F.D. (RE/SPEC, Inc., Rapid City, SD (USA)). 13 Oct 1978. Contract W-7405-ENG-26. 137p. Dep. NTIS, PC A07/MF A01.

This report presents the results of a laboratory effort which was undertaken to determine mechanical properties of salt from Lyons, Kansas. Another goal of the experimental work was to define testing procedures, calibrations and data reduction during the process of generating strength data. Mechanical properties such as modulus of deformation and principal strain ratio were incorporated into simulations of Project Salt Vault using finite element methods. Deformational behavior of Lyons salt subjected to constant stress levels for extended periods of time was also evaluated in this experimental effort and compared to results determined for salt from other locations. Strength data and empirical relationships of strain as a function of time, stress and temperature were reduced for application to finite element analyses.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 43760, 43779

43869 **Geologic-economic bases for the prediction of mineral resources.** Bykhover, N.A. Moscow, USSR; Nedra (1978). 232p. (In Russian).

A presentation is made of a geological-economic evaluation of industrial types of deposits of the most important mineral resources (including fossil fuels), and a description is given of the geological positions and mining technology conditions for the development of the largest deposits that comprise the mineral-raw-material base of the world. The characteristics are shown for the formation and displacement of these deposits. A comparative economic description is made of the identified industrial types of deposits, and a description is given of the technical-economic parameters. A presentation is made of the basic principles and methods of forecasting the potential national economic demand for mineral resources and by-products of their processing, the forecasting of the development of the mining industry, the forecasting of the basic trends of geological survey operations and scientific-technological progress in their production, the evaluation of forecasted reserves of mineral resources and their economic importance. The book is intended for personnel at scientific-research and production geological organizations, and will be of interest to economists in various sectors of the mining industry. 38 references, 65 figures, 16 tables.

43870 **Exploration for and development of deposits of raw materials.** Pogrebitskii, E.O.; Paradeev, S.V.; Porotov, G.S. Moscow, USSR; Nedra (1978). 405p. (In Russian).

The second edition of the book, while retaining the general structure and content of the first edition, differs from the latter by completely eliminating the section dealing with problems in the exploration and survey of certain types of mineral resources. The presentation of such selected data is unjustified since many substantive monographs on practically all types of mineral resources have appeared since the appearance of the first edition. The book contains new chapters: "Principles of the Theory of Exploration, Survey and Evaluation of Deposits," and "Ore (Mine) Geology." The chapters dealing with the research and survey of mineral resources have been revised and supplemented to take account of modern achievements. The book is intended for geologist-students and will be of interest to personnel at geological survey and mining enterprises. 75 references, 107 figures, 57 tables.

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 43776, 43779

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 43695

STARS

REFER ALSO TO CITATION(S) 43878

43871 (LA-UR—79-921) **Nonlinear study of AI Velorum.** Cox, A.N.; Hodson, S.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. (CONF-790364—1). Dep. NTIS, PC A02/MF A01.

From Nonradial and nonlinear stellar pulsation workshop; Tucson, AZ, USA (12 Mar 1979).

Using results from earlier studies of double-mode dwarf Cepheids by Cox, King, and Hodson, hydrodynamic calculations were undertaken for AI Vel. The earlier derived evolution theory mass of 1.8 M sub solar, a luminosity of of 23 L sub solar and a T/sub e/ of 7500°K give the observed period of 0.11 day and the observed period ratio $PI_1/PI_0 = 0.773$. A cooler T/sub e/ than the observed one (7620°K) was used because 7620°K is beyond the fundamental pulsation mode blue edge. The composition used is X = 0.70 Z = 0.01. This lower than normal Z is necessary to make the period ratio as large as observed. The goal is to see if double-mode behavior, due to either mode switching or a permanent state, can be predicted for the model. Progress in converging the model to a periodic pulsation

solution by the von Sengbusch—Stellingwerf relaxation method will be reported. 17 references.

43872 (LA-UR—79-922) **Periods of ZZ Ceti variables.** Cox, A.N.; Hodson, S.W.; Starrfield, S.G. (Los Alamos Scientific Lab., NM (USA); Arizona Univ., Tucson (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790364—3). Dep. NTIS, PC A02/MF A01.

From Nonradial and nonlinear stellar pulsation workshop; Tucson, AZ, USA (12 Mar 1979).

White dwarf pulsators (ZZ Ceti variables) osub solar acccur in the extension of the radial pulsation envelope ionization instability strip to the observed luminosities of 3 x 10^{-3}L sub solar according to van Horn. Investigations were underway to see if the driving mechanisms of hydrogen and helium ionization can cause radial pulsations as they do for the Cepheids, the RR Lyrae variables, and the δ Scuti variables. Masses used in this study are 0.60 and 0.75 M sub solar for T/sub e/ between 10,000 K and 14,000 K, the observed range in T/sub e/. Helium rich surface compositions like Y = 0.78,, Z = 0.02 as well as Y = 0.28, Z = 0.02 were used in spite of observations showing only hydrogen lines in the spectrum. The deep layers are pure carbon, and several transition compositions are included. The models show radial pulsation instabilities for many overtone modes at periods between about 0.3 and 3 seconds. The driving mechanism is mostly helium ionization at 40,000 and 150,000 K. The blue edge at about 14,000 K is probably due to the driving region becoming too shallow, and the red edge at 10,000 K is due to so much convection in the pulsation deriving region that no radiative luminosity is available for modulation by the γ and κ effects. It is speculated that the very long observed periods (100 to 1000 sec) of ZZ Ceti variables are not due to nonradial pulsations, but are possibly aliases due to data undersampling. 4 references.

43873 (N—79-11154) **Isotopic anomalies from neutron reactions during explosive carbon burning.** Lee, T.; Schramm, D.N.; Wefel, J.P.; Blake, J.B. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 31 Oct 1978. 27p. NTIS PC A02/MF A01.

The possibility that the newly discovered correlated isotopic anomalies for heavy elements in the Allende meteorite were synthesized in the secondary neutron capture episode during the explosive carbon burning, the possible source of the O-16 and Al-26 anomalies, is examined. Explosive carbon burning calculations under typical conditions were first performed to generate time profiles of temperature, density, and free particle concentrations. These quantities were inputted into a general neutron capture code which calculates the resulting isotopic pattern from exposing the preexisting heavy seed nuclei to these free particles during the explosive carbon burning conditions. The interpretation avoids the problem of the Sr isotopic data and may resolve the conflict between the time scales inferred from 1-129, Pu-244, and Al-26.

43874 (N—79-11979) **Nh3 in IRC plus 10216.** Betz, A.L.; Mclaren, R.A.; Spears, D.L. (California Univ., Berkeley (USA). Dept. of Physics). 1978. Contracts NGR-05-003-452;NGL-05-003-272. 16p. NTIS PC A02/MF A01.

Ammonia was detected in the circumstellar envelope of IRC +10216 by means of three infrared absorption lines in the nu sup 2 band around 950/cm. The lines are fully resolved at a resolution of 0.22 km/sec and indicate that most of the circumstellar gas is accelerated to expansion velocities around 14 km/sec within a few stellar radii. The NH3 profiles indicate a rotational temperature between 400 and 700 K, and H2 density between 10 to the 8th power/cu cm and 10 to the 10th power/cu cm, and NH3 column density of 10 to the 17th power/sq cm. The H2 density indicates that the mass of the circumstellar envelope within a 1 arcsec radius is approximately 0.1 solar masses.

43875 (UCRL—82152) **Production of high energy neutrinos in relativistic supernova shock waves.** Weaver, T.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1979. Contract W-7405-ENG-48. 12p. (CONF-7808107—1). Dep. NTIS, PC A02/MF A01.

From 1978 DUMAD summer workshop; San Diego, CA, USA (11 Aug 1978).

The possibility of producing high-energy neutrinos (> ~ 10 GeV) in relativistic supernova shock waves is considered. It is shown that, even if the dissipation in such shocks is due to hard hadron—hadron collisions, the resulting flux of neutrinos is too small to be observed by currently envisioned detectors. The associated burst of hard γ-rays, however, may be detectable. 3 tables.

43876 **Is the muon-neutrino mass in the range 100—500 keV?.** Goldman, T.; Stephenson, G.J. Jr. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **19**: No. 7, 2215-2218(1 Apr 1979).

Cowsik's argument on neutrino lifetimes must be modified if the neutrinos are sufficiently massive. Neutrinos of masses greater than 100—700 keV and which decay into much lighter neutrinos and a photon are consistent with astrophysical data on white dwarf stars. Experimental muon-neutrino mass limits combined with our arguments require masses of less than a few eV (and lifetimes greater than 10^{22} sec), or in the range ~ 100—500 keV.

43877 **Is radiative decay of neutral leptons the mechanism for stripping of supernova envelopes?.** Zatsepin, G.T.; Smirnov, A.Y. (Institute of Nuclear Research, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 350-352(20 Sep 1978).

The production of a neutral lepton L^0 with a mass on the order of several MeV in the core of a supernova and its radiative decay $L^0 \rightarrow L$@sup 0prime@γ in the envelope can lead to a stripping of the latter. L^0 can be identified with the tau neutrino, and L@sup 0prime@ with ν@sub e@ or ν/sub μ/.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

43878 (N—79-11081) **Extreme uv/x-ray survey satellite mission. Report on phase A study.** (European Space Agency, 75 - Paris (France)). 27 Apr 1978. 91p. NTIS PC A05/MF A01.

The phase A study of an extreme ultraviolet (EUV, wavelength range 100 to 1000 A) / soft X ray (XUV, 15 to 250 A) survey satellite (EXUV) for all-sky survey of stellar sources is reported. Two independent grazing incidence telescopes of the nested Wolter type, each of 60 cm aperture, are proposed. The focal plane package of the EUV telescope consists of a micro-channel plate detector and a set of optimized bandpass filters (140 to 280 A, 170 to 490 A, 400 to 570 A, 475 to 715 A), providing 4 color photometry. The XUV focal plane package contains a thin (15 to 250 A) and a thick (15 to 150 A) window position-sensitive proportional counter and a gas scintillation proportional counter. Because of the better spectral resolution, the lastmentioned detector will be used for more detailed spectral studies of the diffuse XUV emission. The mission concept envisages a spinning spacecraft launched into a two-day highly eccentric equatorial orbit (apogee 120,000 km) by Ariane using a dual launch configuration. All-sky survey is achieved by mounting the telescope axes perpendicular to the spin axis of the body-stabilized spacecraft. The axis is pointed to the sun at the perigee of the orbit by a precession maneuver, giving a series of slightly overlapping great circle scans. For extended observations of particular sources, a 30 deg offset capability is included. Data is transmitted in real time at a constant rate via an experiment buffer to ESA ground stations.

43879 (N—79-11968) **A search for x-ray pulsations from the galactic center. Final report.** Cordova, F.A.; Garmire, G.P.; Lewin, W.H.G. (California Inst. of Tech., Pasadena (USA)). Nov 1978. 13p. NTIS PC A02/MF A01.

Data from the SAS-3 satellite were used in a search for X-ray pulsations from the direction of the galactic center. No periodic X-ray behavior was detected in the frequency interval 0.6 Hz to 0.0006 Hz and energy range 2.5 - 35 keV. For periods less than 60 sec, the upper limit to the amplitude of any pulsation in the 2.5 - 10 keV band is approximately .0017 cts/sq cm/s. This corresponds to a pulsed fraction of approximately 1.3 percent of the total GCX flux. Somewhat higher limits apply for longer periods and for energies greater than 10 keV.

43880 (N—79-11969) **Recent measurements with a balloon borne Ge (Li) spectrometer in gamma-ray astronomy.** Dacosta, J.M.; Boclet, D.; Claisse, J.; Durouchoux, P.; Pagnier, P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1977. 27p. NTIS PC A03/MF A01.

A high resolution gamma ray spectrometer for stellar measurements was developed. The instrument consists of a large Ge(Li) crystal (140 cu cm) cooled at liquid nitrogen temperature and actively shielded by a sodium iodide crystal. Spectral resolution and effective area are respectively 3.0 KeV (F.W.H.M.) and 2.7 sq cm at 1 MeV. Three successful flights were carried on board a stabilized gondola. The background total counting rate was about 10 counts/s in the 0.1-8 MeV energy range at floating altitude (2.8g/sq cm residual atmosphere, 12 GV cut off-rigidity). The sensitivity of the detector is about 10 to the minus three power/sq cm/s over the energy range for three hours of observation of a point source. Preliminary results and future developments are described.

43881 **Application of the methods of mathematical experiment theory to the investigation of quasars.** Klyakotko, M.A. (All-Union Astronomical and Geodesic Society). *Sov. Astron. AJ (Engl. Transl.);* **22**: No. 6, 753-756(Nov 1978).

A classification of quasars is made using the method of principal components. It is shown that the 57 quasars investigated can be separated into four clusters in which, in turn, chains can be distinguished. This indicates a nonuniformity of quasars with respect to their physical characteristics.

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 43689

43882 (PB—288965) **Solar-geophysical data number 409, September 1978. part II. (comprehensive reports). data for March 1978--February 1978 and miscellanea.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Sep 1978. 51p.

This comprehensive report for March 1978, February 1978 and Miscellaneous data provides data on: active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, and regional flare index.

43883 (PB—289191) **Solar-geophysical Data number 409, September 1978, part I. (prompt reports). data for August 1978, July 1978.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Sep 1978. 147p.

This prompt report provides data for August 1978 on: alert period, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, coronal holes, inferred IP magnetic field polarities, mean solar magnetic field, solar wind measurements, and Boulder geomagnetic substorm log. It also provides data for July 1978 on: daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices.

43884 **ISEE-1 and ISEE-2 fast plasma experiment and the ISEE-1 solar wind experiment.** Bame, S.J.; Asbridge, J.R.; Felthauser, H.E.; Glore, J.P.; Paschmann, G.; Hemmerich, P.; Lehmann, K.; Rosenbauer, H. (Univ of Calif, Los Alamos Sci Lab, NM). *IEEE Trans. Geosci. Electron.;* **GE-16**: No. 3, 216-220(Jul 1978).

Identical fast plasma experiment (FPE) systems were placed on the ISEE-1 and ISEE-2 spacecraft. The FPE consists of three high-efficiency 90° spherical section electrostatic analyzers using large secondary emitters and discrete dynode multipliers to detect analyzed particles. Two of them, viewing in opposite directions, produce complete 2D velocity distribution measurements of both protons and electrons every spacecraft revolution. A third FPE analyzer with a divided emitter measures 3D distributions at a slower rate. ISEE-1 also carries a solar-wind experiment (SWE) to measure solar-wind ions with high resolution. The SWE is composed of two 150° spherical section analyzers using the same set of plates. The two acceptance fans are tilted with respect to each other so that 3D characteristics of the ion distributions can be derived.

GALAXIES

43885 **Correlation between the optical and x-ray variability of NGC 4151.** Lyutyi, V.M. (Crimean Station, Shternberg Astronomical Institute). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 6, 267-269(Nov 1978).

A comparison of x-ray and optical observations of the variable Seyfert galaxy during 1971—1976 reveals a correlation for both the slow and the fast components of the light curves. The optical variability may lag that in the x-ray range. The x-ray variability has a larger amplitude and a shorter time scale.

COSMOLOGY

REFER ALSO TO CITATION(S) 43873

43886 **Cosmological constraints on new stable hadrons.** Dover, C.B.; Gaisser, T.K.; Steigman, G. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev. Lett.;* **42**: No. 17, 1117-1120(23 Apr 1979).

Possible new hadrons containing massive stable quarks (e.g., color-sextet quarks) surviving as relics of the early stages of the big bang should be present in $Z > 1$ nuclei at levels accessible to experiment ($\sim 10^{-10}$). Grand unified theories that explain the observed baryon asymmetry of the universe should not contain these new stable quarks unless they are prevented from evolving asymmetrically. Otherwise, the new hadrons would be as common as nucleons, which is clearly not the case.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 43906

43887 (N—79-11993) **Maps of Jovian radio emission at 1412 MHz. Final technical report, 15 Jan. - 15 Oct. 1978.** Pater, I.D. (Rijksuniversiteit Leiden (Netherlands)). 15 Oct 1978. 28p. NTIS PC A03/MF A01.

Jupiter was observed with the Westerbork Radio Telescope at a frequency of 1412 MHz in December 1977 when it was at its most northerly opposition to the earth. Pictures were obtained of Jupiter in all four Stokes parameters at 24 different rotational aspects of the planet, each integrated over 15 degrees of Jovian rotation. The maps clearly indicate the presence of higher order terms in the dipolar field of Jupiter at distances of approximately 2 Rj from the center. They also show a displacement of the main dipole of 0.119 plus or minus 0.009 Rj from the center of the disk towards longitude 135-145 degree and a displacement of 0.04 plus or minus 0.04 Rj towards the north in agreement with the displacement found by the Pioneer spacecraft. From the data it is estimated that the thermal disk temperature at this frequency is more than 300 K but less than 340 K, which implies an ammonia mixing ratio of approximately 0.0005.

43888 **Biological implications of the Viking mission to Mars.** Mazur, P. (Oak Ridge National Lab., TN (USA)); Barghoorn, E.S. (Harvard Univ., Cambridge, MA (USA). Dept. of Biology); Halvorson, H.O. (Brandeis Univ., Waltham, MA (USA)); Jukes, T.H. (California Univ., Berkeley (USA). Space Sciences Lab.); Kaplan, I.R. (California Univ., Los Angeles (USA)); Margulis, L. (Boston Univ., MA (USA)). *Space Sci. Rev.;* **22**: No. 1, 3-34(Jun 1978).

A central purpose of Viking was to search for evidence that life exists on Mars or may have existed in the past. The missions carried three biology experiments the prime purpose of which was to seek for existing microbial life. They produced clear evidence of chemical reactivity in soil samples, but it is becoming increasingly clear that the chemical reactions were nonbiological in origin. The unexpected release of oxygen by soil moistened with water vapor in the Gas Exchange experiment together with the negative findings of the organic analysis experiment lead to the conclusion that the surface contains powerful oxidants. This conclusion is consistent with models of the atmosphere. The oxidants appear also to have been responsible for the decarboxylation of the organic nutrients that were introduced in the Label Release experiment. The major results of the GEX and LR experiments have been simulated at least qualitatively on Earth. The third, Pyrolytic Release, experiment obtained evidence for organic synthesis by soil samples. Although the mechanism of the synthesis is obscure, the thermal stability of the reaction makes a biological explanation most unlikely. Furthermore, the response of soil samples in all three experiments to the addition of water is not consistent with a biological interpretation.

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

43889 (N—79-11592) **Basic principles of incoherent scattering and its contribution to physical studies of the upper atmosphere principios basicos em espalhamento incogrente e sua contribuicao para o estudo da fisica na atmosfera superior.** Kirchhoff, V.W.J.H. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Sep 1977. 17p. NTIS PC A02/MF A01.

The theory of incoherent scatter is presented from a practical point of view. Considerations on frequency of operation, spectrum, equipment and data analysis were reviewed and its contributions to the study of the upper atmosphere and ionosphere are summarized. The description stresses the physical processes rather than the mathematical treatment.

43890 (N—79-11593) **Physics of the ionosphere ionosfera - atmosfera superior - fisica.** Bittencourt, J.A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jan 1978. 53p. NTIS PC A04/MF A01.

A review of the basic concepts of ionospheric physics is presented. The dynamics of the upper neutral atmosphere related to studies of the ionosphere, the formation of the ionosphere, the differences in the various ionospheric layers, physical and chemical processes, ionospheric phenomenon, wave propagation, and a method for measuring ionospheric plasma parameters are presented.

43891 (N—79-11612) **Occurrences of the polar slant E condition-SEC at Narssarssuaq, Godhavn, Thule, 1975.** Primdahl, I.S. (Danish Meteorological Inst., Copenhagen). 1977. 46p. NTIS PC A03/MF A01.

Tables of slant E condition (SEC) occurrences scaled from the ionograms of Thule, Godhavn and Narssarssuaq (Greenland) for the year 1975 are presented.

43892 (PB—288967) **A comparative study of methods of electron density profile analysis. Chairman's report, URSI subgroup G/6/2 on n(h) analysis.** McNamara, L.F. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Sep 1978. 65p.

URSI Subgroup G/6/2 was charged with comparing available methods of real-height analysis of ionograms in order to determine the best method. Experts in the field who composed the subgroup attempted to compare all known available methods. The comparisons were made on the basis of the accuracy of the results obtained by each method in the analyses of a series of accurate numerical ionograms, with the correct results being known only to the chairman. Of those methods for which sufficient results were presented to allow definitive conclusions to be drawn, those of A. K. Paul (Boulder, Colorado, U.S.A.) and J. E. Titheridge (Auckland, N.Z.) proved to be the most promising.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 43883

43893 (N—79-11594) **Annual and semi-annual variation in the h-field at vassouras.** Trivedi, N.B.; Kantor, I.J.; Dacosta, J.M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jan 1978. 15p. NTIS PC A02/MF A01.

Vassouras H-field data during the period 1957-68 were subjected to harmonic analysis and spectrum analysis by the maximum entropy method. The amplitudes of the annual and semi-annual components were computed. Similar computations were carried out for equatorial Dst data for the period 1957-70 and amplitudes of annual and semi-annual waves were computed. The results are discussed and compared. It seems that the annual wave could have a significant contribution from currents of magnetospheric origin.

43894 (N—79-11610) **Rude Skov geophysical observatory. Magnetic results, 1973.** (Danish Meteorological Inst., Copenhagen). 1977. 41p. NTIS PC A03/MF A01.

The results of the standard observations carried out at Rude Skov magnetic observatory during 1973 are presented. The measurements show hourly means of horizontal and vertical intensity and hourly means of magnetic declination. Diurnal extreme values and mean diurnal inequalities are also given.

43895 (N—79-11611) **Rude Skov geophysical observatory. Magnetic results, 1974.** (Danish Meteorological Inst., Copenhagen). 1977. 36p. NTIS PC A03/MF A01.

The results of the standard observations carried out at the Rude Skov magnetic laboratory during 1974 are presented. The measurements show hourly means of horizontal and vertical intensity and hourly means of magnetic declination. Diurnal extreme values and mean diurnal inequalities are also given.

43896 (N—79-11614) **A review of selected topics in magnetospheric physics.** Morfill, G.E. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). Jul 1977. 200p. NTIS PC A09/MF A01.

The basic physical processes and recent progress in magnetospheric physics are reviewed. The topics are: magnetopause, plasmasphere, proton radiation belt, wave-particle interaction, electron radiation belt, wave excitation, aurorae, plasma mantle, plasma sheet, and magnetospheres other than terrestrial. For each, the basic theory and necessary topological considerations are detailed, together with a presentation of the most recent experimental verifications.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

43897 (UCRL—82194) **Xenon shock waves driven by high magnetic fields.** Shearer, J.W.; Beasley, J.W.; Reyenga, A.; Steinberg, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 25p. (CONF-790540—6). Dep. NTIS, PC A02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

Magnetic fields in the range 0.2 to 2.0 MG produce shocks in 0.1 to 1.0 atmosphere xenon gas which have shock mach numbers as high as 100. Using pulsed x-ray and other diagnostics, the studies of velocity, compression, and luminosity are in good agreement with a simple snowplow theory. In some of the experiments, ultraviolet radiation from the shocked xenon produces luminous precursors and interactions with the metal walls of the shock tube. The addition of an ultraviolet absorbing organic impurity vapor diminishes the amplitude of these effects. A clean, chemically inert metal wall is even more effective. Further experiments show that magnetic shear has a stabilizing effect on the current-carrying layer of the shocked gas. It is concluded that a megagauss magnetic field is a useful shock tube driver for producing high velocity shock waves.

43898 **Introduction to the school program.** Fano, U. (Univ. of Chicago, IL). pp 1-9 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Development of atomic theory is reviewed. Topics covered include: classes of processes and their interconnections; theoretical descriptions, scattering matrix and its variants; and analysis and calculation of interaction effects. (GHT)

43899 **Ionization by nuclear transitions.** Freedman, M.S. (Argonne National Lab., IL). pp 255-271 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Ionization and excitation in an atom induced by nuclear processes are reviewed. Topics covered include: shakeoff in internal conversion; shakeoff in electron capture; shakeoff in beta decay; and inner electron ejection in alpha decay. (GHT)

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 43917

43900 (CONF-790437—8) **Ion implanted Na^{22} source for positron lifetime measurements.** Fluss, M.J.; Smedeskjaer, L.C. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

A new positron source-sample fabrication technique, intended for high temperature positron annihilation measurements, was developed. The method makes use of a mass separator to implant pure Na^{22} into the sample surface. The application of this technique to Cu is described. A brief discussion of the origin of the source component is given, and different possibilities of correcting for it are pointed out. 3 references.

43901 **Electron scavenging in glasses.** Shlesinger, M.F. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *J. Chem. Phys.;* **70**: No. 11, 4813-4818(1 Jun 1979).

Electron scavenging reactions in amorphous media are analyzed using a random walk hopping model, which can yield a time dependent rate constant. The underlying waiting time distribution for the time between hops is shown to be able to lead to an exponential of a fractional power of time decay of the reactants, as opposed to simple exponential decay. This type of kinetic behavior has been found by Hamill and Funabashi when replotting electron scavenging data in an appropriate manner. A different waiting time distribution which has been used for the analysis of charge transfer in amorphous xerographic films is shown to lead to an algebraic decay law, as has been observed in various phosphors.

43902 **Low-cost digital system for control of a retarding potential energy analyzer.** Harrison, A.R.; Hodge, L.A.; Mahan, A.H.; Dunning, F.B. (Department of Physics, Rice University, Houston, Texas 77001). *Rev. Sci. Instrum.;* **50**: No. 6, 741-742(Jun 1979).

A simple, low-cost digital system is described which is used in conjuction with a conventional retarding potential analyzer to measure the energy distribution of the electrons in a beam.

43903 **Radiative electron capture by oxygen ions in single-crystal channels: Experiment and theory.** Appleton, B.R.; Ritchie, R.H.; Biggerstaff, J.A.; Noggle, T.S.; Datz, S.; Moak, C.D.; Verbeek, H.; Neelavathi, V.N. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **19**: No. 9, 4347-4362(1 May 1979).

The phenomenon of radiative electron capture (REC) has been studied for 17—40-MeV O ions channeled through thin single crystals of Ag and Si. As a consequence of the unique constraints imposed on the interactions of well-channeled ions it is possible to study the REC phenomenon for fully stripped oxygen ions interacting primarily with the free or weakly bound electrons in single-crystal channels. Radiation is identified which results from electrons captured directly into the lowest-energy state of the moving oxygen ions as well as that arising from a number of bremsstrahlung processes. The measured cross sections and widths of the REC radiation and the bremsstrahlung processes are compared to calculations made specifically for the channeling situation. The calculations incorporate standard radiation theory and a statistical model of the electron states in the single crystal. The space-varying electron density is averaged over impact parameters appropriate for the channeled ions. The measured REC cross sections show a marked deviation from theory which is not understood at this time. The shapes of the REC lines and the x-ray background present in the measured spectra are in reasonable agreement with the calculations, but the widths of the REC lines as a function of ion energy show only fair agreement. Results of these studies are discussed and possible explanations offered for some of the discrepancies.

43904 **Scattering of low-energy electrons on micron-size pinholes.** Spears, D.P.; Allen, J.D.; Anderson, V.E.; Becker, R.S.; Hubbell, H.H. Jr.; Ferrell, T.L.; Ritchie, R.H.; Birkhoff, R.D. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Appl. Phys.;* **50**: No. 5, 3039-3043(May 1979).

In exploring forces between charged particles and surfaces, we have sent a beam of low-energy (0.5—40 eV) electrons through two (laser drilled) micron-size pinholes in thin films of gold spaced 10 cm apart. Image forces associated with the solid around the second pinhole cause the beam to diverge into an angular distribu-

tion which is scanned with a movable slit and Channeltron detector. Distributions have widths which depend inversely on electron energy as expected from transit time considerations. The paraxial portion of the distribution appears to diverge as though from a weak negative electron lens. The impulse approximation for the radial component of the electron motion is used to derive a radial potential averaged along a line parallel to the pinhole axis. This potential approximately equals the expected value e/4x at x<10 A from the pinhole edge but deviates from this function at greater distances. This deviation may be due to geometric effects, to the impulse collision model employed, or to geometric irregularities at the edge. The results are useful in estimating efficiencies of filters for charged aerosol collection.

43905 Deuterium-ion-beam impurities produced by a gas-discharge ion source (duopigatron). Bickes, R.W. Jr.; O'Hagan, J.B. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **50**: No. 5, 3247-3249(May 1979).

Mass-spectroscopic analyses of dc deuterium-ion beams produced by a duopigatron ion source were carried out. These analyses showed that under normal operating conditions the beams contained less than 1% of impurities and consisted primarily of masses 12, 14, 16, 18, 20, and 22 and some metal ions. The source of the metal contaminants was the secondary cathode. Several cathode materials including Mo, Al, Al_2O_3, BN, and TiB_2 were tested.

43906 Mass effects on angular distribution of sputtered atoms. Olson, R.R.; King, M.E.; Wehner, G.K. (Electrical Engineering Department, University of Minnesota, Minneapolis, Minnesota 55455). *J. Appl. Phys.;* **50**: No. 5, 3677-3683(May 1979).

Sputtering metal targets at low ion energies (Hg or Ar at <300 eV) under normal ion incidence causes the lighter atoms (lighter isotopes or lighter elements of alloys) to be preferentially ejected in a direction normal to the target surface. Experimental results are shown for several elements and alloys at various bombardment energies. The amount of enrichment of the lighter species normal to the target surface decreases quite rapidly with increasing ion energy. The phenomenon is a result of reflective collisions because lighter atoms can be backscattered from heavier ones underneath but not vice versa. The effect provides an explanation why solar-wind-exposed lunar material is enriched in the heavier isotopes since sputtered lower-mass elements have a higher chance of achieving the lunar escape velocity.

43907 Observation of radiation from channeled positrons. Alguard, M.J.; Swent, R.L.; Pantell, R.H.; Berman, B.L.; Bloom, S.D.; Datz, S. (Department of Electrical Engineering, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **42**: No. 17, 1148-1151(23 Apr 1979).

Radiation from 56-MeV positrons ($\gamma < 111$) channeled between the major planes of along the <110> axis of an 18-μm-thick silicon crystal has been observed. The energies of the measured planar-channeling spectral peaks agree well with theoretical predictions.

43908 Quadrupole interaction in the scattering of H_2 from the surface of LiF: Rotational transitions. Hill, N.R. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 4269-4276(15 Apr 1979).

It is shown that when H_2 is scattered from the (001) surface of a LiF crystal, the quadrupole moments of the incident molecule interact with the electric field of the crystal to couple translational and rotational modes. This interaction causes rotational transition probabilities which are comparable in magnitude to those measured experimentally and to those calculated to result from other interaction mechanisms.

ATOMIC AND MOLECULAR PROPERTIES

43909 (LA-UR—79-660) **Partial photoionization cross sections and radiative recombination rate coefficients for Li-like ions - II.** Barfield, W.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

A nonhydrogenic single-electron-transition model with Dirac—Slater SCF wave functions and all necessary multipoles was used to obtain partial photoionization cross sections for C^{+3}, O^{+5}, Al^{+10}, Fe^{+23}, and Mo^{+39} for principal quantum number n = 10 and all l, $h\nu \leqq 200$ keV, supplementing results reported elsewhere for n = 2, 3, 4, and 6. The partial cross sections for the isoelectronic sequence are represented approximately by a simple analytical form. The n^{-3} scaling is used to obtain partial cross sections for other values of n ($6 < n < 10$, $10 < n < 100$). Radiative recombination rate coefficients (summed over l and $n < 100$) were calculated from the partial photoionization cross sections for kT = .01, .03, 0.1, 0.3, 1.0, 3.0 and 10.0 keV. The results have application to ionization balance calculations for the solar corona and for TOKAMAKS. 9 references.

43910 Electronic structure of UCl_6: Photoelectron spectra and scattered wave Xα calculations. Thornton, G.; Edelstein, N.; Roesch, N.; Egdell, R.G.; Woodwark, D.R. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Chem. Phys.;* **70**: No. 11, 5218-5221(1 Jun 1979).

Helium I and II excited photoelectron (p.e.) spectra of UCl_6 are reported. Experimental ionization energies agree well with those predicted by a quasirelativistic scattered wave Xα calculation; further support for the proposed assignments is provided by a consideration of intensity patterns in the spectra. Attention is ultimately focused on the relationship between ionization energies and charge transfer electronic excitation energies in hexahalo complexes. Further experimental work is required to establish an assignment for the electronic absorption spectrum of UCl_6.

43911 Photoionization of the $(np)^4$ $^1S_0$ level of the group-VI atoms via autoionizing levels. McGuire, E.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Rev., A;* **19**: No. 5, 1978-1998(May 1979).

Calculations are presented for the effective photoionization cross section of the $(ns)^2$ $(np)^4$ $^1S_0$ level in O, S, Se, and Te, via excitation to autoionizing levels. The eigenvalues and eigenfunctions of 67 odd-parity levels with $J < 1$, both bound and autoionizing, are obtained via the diagonalization of a matrix including both configuration and spin-orbit interaction. The diagonal entries in the matrix are experimental values, where possible, as a constraint on the calculations was agreement between calculated and experimental energy levels to better than 200 cm^{-1}. The $(ns)^1$ $(np)^5$ $^3P_1$ and $^1P_1$ levels are included, but do not satisfy the constraint for S, Se, and Te. The calculations on Te support the tentative level identifications of Bartelt, and suggest that the Te ionization potential in Moore's Tables in 800 cm^{-1} too low. The calculations indicate that while the effective photoionization cross section for $(np)^4$ ^1S is surprisingly large and broad for S, Se, and Te, there are windows in the spectrum for S and Se. These windows would permit efficient production of large ^1S population densities via photodissociation of OCS or OCSe without substantial quenching of the ^1S population via photoionization and secondary-electron superelastic scattering, e.g., Se at 1720 A.

43912 Inclusion of ion dynamics in the unified classical path theory of Stark broadening. Greene, R.L. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32611). *Phys. Rev., A;* **19**: No. 5, 2002-2008(May 1979).

A theory of Stark broadening of hydrogenic radiators which adds ion dynamic corrections to the unified theory of Smith, Cooper, and Vidal is presented. The dynamic parts of the ion collisions are treated in an impactlike approximation, which is justified for certain plasma conditions by the static-ion field cutoff in the ion interaction integrals. Approximate results are presented for the Lyman-α, Lyman-β, and H-α lines of hydrogen, and comparison is made to experiment and to other theories.

43913 Resonant contributions to single charge transfer between He^{2+} and He. Bardsley, J.N.; Cohen, J.S.; Wadehra, J.M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., A;* **19**: No. 5, 2129-2130(May 1979).

Energy levels and lifetimes are calculated for the resonant states that are important in radiative single charge transfer in He^{2+}-He collisions at thermal energies. The resonant contribution to the charge-transfer rate decreases with increasing temperature and is approximately 12% of the total rate at 300 K.

43914 Extended two-level theory of the exponential index of multiphoton processes. Eberly, J.H. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80309). *Phys. Rev. Lett.;* **42**: No. 16, 1049-1052(16 Apr 1979).

A nonperturbative formula is given for the r-photon-resonant, (r + p) -photon ionization rate of an atom and from it is derived an expression for the exponential index.

43915 Relative oscillator strengths of the spectral lines of holmium. Blagoev, K.B.; Valter, A.K.; Komarovskii, V.A. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **45**: No. 6, 932-933(Dec 1978).

The oscillator strengths of 29 absorbtion lines in HoI have been determined by Rozhdestvenskii's method of hooks. (AIP)

43916 Ab initio static polarisabilities of N_2 and linear symmetric CO_2 in the Hartree-Fock approximation: variation with internuclear separation. Morrison, M.A.; Hay, P.J. (Los Alamos Scientific Lab., NM). *J. Phys., B (London);* **10**: No. 17, L647-L652(1977).

Ab initio SCF calculations in the Hartree—Fock approximation of static parallel and perpendicular polarizabilities and their first derivatives for CO_2 and N_2 are reported. For N_2, results for values of the internuclear separation from 1.7 to 2.4 a_0 are presented. For CO_2, only the linear symmetric-stretch geometries are considered,

and polarizabilities are given for values of the oxygen-carbon separation from 2.0 to 2.4 a_0. 32 references.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

43917 (BNL—26084) **Slow positron studies on single crystals of Ag(100), Ag(111) and Cu(111).** Lynn, K.G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 10p. (CONF-790437—5). Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Monoenergetic positrons were employed to examine positronium formation as a function of sample temperature (300 to 1200 K) and incident energy (0 to 5 keV) on Ag(100), Ag(111) and Cu(111) surfaces with submonolayer contamination. In these metals at the higher temperatures, positronium formation becomes the dominant process. A one-dimensional diffusion model is fit to the data as a function of incident energy. Th positronium fraction is found to be an activated process and is identified as detrapping from a surface state and an estimate of the depth of this trap is extracted. The diffusion length is found to be temperature independent before the onset of vacancy trapping. At the higher temperatures vacancy trapping is observed by the decrease in the positron diffusion length at the higher incident voltages. A vacancy formation energy is extracted from the data and is generally lower than the accepted bulk values. 18 references.

43918 (CONF-790437—4) **Interpretation of combined measurements of positron mean-lifetime and Doppler-broadened lineshape in aluminum and copper.** Tam, S.W.; Siegel, R.W.; Fluss, M.J.; Smedskjaer, L.C. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 5p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on positron annihilation; Lake Yamanaka, Japan (8 Apr 1979).

Combined measurements of the positron mean-lifetime, anti tau, and the Doppler-broadened lineshape-parameter F in Al and Cu yield plots of anti tau versus F that exhibit curvature. Two possible interpretations of the Al data are considered, both of which seem to account reasonably well for the observed curvature. The first interpretation is based upon the conventional two-state trapping model, in which the bulk (Bloch) state and monovacancy-trapped state are the only states from which a positron can be annihilated. At least part of the curvature in anti tau vs F is explained by the fact that, in general, (d tau/sub b//dT)/(dF/sub b//dT) differs from (tau/sub v/-tau/sub b/)/(F/sub v/-F/sub b/). The second approach used to analyze the Al data is based upon a three-state trapping model in which divacancies as well as monovacancies are considered as possible positron traps. In this case an improvement in the fit to the Al data was obtained using physically reasonable divacancy parameters, thus indicating a possible future application of such combined measurements. The two-state trapping model analysis of the Cu data also indicates that the temperature dependences of tau/sub b/ and F/sub b/ contribute significantly to the curvature of the anti tau vs F plot. 7 references.

43919 **Giant hyperfine anomaly between bound negative muon and Rh nucleus in Pd metal.** Yamazaki, T.; Hayano, R.S.; Kuno, Y.; Imazato, J.; Nagamine, K.; Kohn, S.E.; Huang, C.Y. (Faculty of Science, University of Tokyo, Bunkyo-ku, Tokyo, Japan). *Phys. Rev. Lett.;* **42**: No. 18, 1241-1245(30 Apr 1979).

The Knight shift of negative muon (μ^- Pd) in Pd metal has been determined to be -(9.0 +- 0.7) % at $T < 11$ K, revealing an unusually large hyperfine anomaly between μ^- Pd and its equivalent isotope RhPd; H@sub hf@(μ^- Pd)/H@sub hf@(RhPd) < 0.64 +- 0.05, or ϵ/sub μ/ - ϵ/sub N/ $< -(36$ +- 5) %. Its implication is discussed in terms of the spatial distribution of the electron spin density in transition metals.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 44022

43920 (AD-A—060118) **Do highly excited reactive polyatomic molecules behave ergodically. Technical report.** Oref, I.; Rabinovitch, B.S. (Washington Univ., Seattle (USA). Dept. of Chemistry). 1 Oct 1978. Contract N00014-75-C-0690. 33p. NTIS PC A03/MF A01.

Existing literature is surveyed and critically analysed. A variety of excitation techniques including crossed molecular beam, laser, photochemical, chemical activation and thermal are considered. Models of collisional perturbation relaxation and energy transfer are compared with literature evidence. The answer to the title question is yes.

43921 (CONF-790524—3) **Fate of electrons with energies less than 100 eV.** Stockdale, J.A.D. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 6. international congress symposium on radiation research and stem cells; Tokyo, Japan (13 May 1979).

An introduction is given to some of the major processes which take place when low energy electrons collide with molecules. Temporary negative ion states, dissociative electron attachment, and vibrational and rotational excitation are emphasized. Resonances and some comments on H_2O are also covered. 45 references. (JFP)

43922 (COO—2542-6) **Dynamical studies of molecular systems. Progress report, February 1, 1978—November 1, 1978.** Rabitz, H. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1978. Contract EY-76-S-02-2542. 18p. Dep. NTIS, PC A02/MF A01.

During the past year the research under the contract has evolved along several lines consistent with the goal of achieving a better understanding of the interaction of molecules. First, was developed appropriate theoretical collision techniques and then implementation for practical systems of interest. This activity emphasized the determination of key physical factors controlling inelastic collision behavior. Also new methods were developed for inverting experimental relaxation data to yield detailed state-to-state rate constants. In addition a new effort was undertaken to develop efficient sensitivity analysis techniques for probing parameter dependencies in chemical kinetics systems. In summary, research on the following topics was pursued: physical analysis of atom-symmetric top collisions, vibration-rotation inelastic collisions in the CO-He System, collisional excitation of interstellar molecules: H_2, sensitivity analysis in quantum dynamics, correlation of relaxation data: application to (A^1Sigma/sub u/)Na_2*-Xe, vibrational-rotational relaxation from high vibrational state, in He-HD, the Green's function method of sensitivity analysis in chemical kinetics, and the classical path approximation in time-dependent quantum collision theory. The essence of these various activities is described in the body of this report. The publications resulting from this research contain further detailed information, and these papers are listed at the end of the report.

43923 (COO—2753-104) **Atomic expansion method for electron capture in ion-atom collisions.** Lin, C.D. (Kansas State Univ., Manhattan (USA)). 1978. Contract EY-76-S-02-2753. 6p. (CONF-781113—36). Dep. NTIS, PC A02/MF A01.

From 5. conference on application of small accelerators; Denton, TX, USA (6 Nov 1978).

The theory of electron capture in multielectron ion-atom collisions based upon the atomic expansion method for collisions at a few keV/amu to a few MeV/amu is considered. Single-electron transfer processes are primarily considered. First-order perturbation theories for charge transfer, the K—K electron capture cross sections in heavy ion-atom collisions, the differential cross sections for electron transfer, electron capture from L- and M-subshells, quasimolecular binding correction to the atomic expansion method, and further improvement of the theoretical model are treated. 25 references. (JFP)

43924 **Laser spectroscopy and predissociation of molecules.** Lehmann, J.C. (Ecole Normale Superieure, Paris, France). pp 167-178 of Atomic Physics 5. Marrus, R.; Prior, M.; Shugart, H. (eds.). New York, NY; Plenum Press (1977).

From 5. international conference on atomic physics; Berkeley, CA, USA (26 Jul 1976).

It is shown how lifetime measurements can give information on small predissociation effects. Most probably many molecular energy levels which are presently believed to be stable are actually subjected to weak or very weak predissociations. It should be possible to study these effects and therefore to go one step further in the understanding of simple molecules. Magnetic predissociations should also exist for many molecules and, by combining lifetime measurements with the use of high or very high magnetic fields, such effects could be studied. Finally, the very general idea that a quantum interference effect in which a very small effect interferes with a large one, always gives a possibility of measuring very small quantities. This idea can be applied in many fields.

43925 (N—79-11853) **Adiabatic potentials and diabatic matrix elements for the alkali mercury systems Na, K, Rb and Cs.** Dueren, R. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (Germany, F.R.)). Sep 1977. 37p. NTIS PC A03/MF A01.

Full listings of the adiabatic potentials and the diabatic matrix elements are given for the interaction of Na, K, Rb, and Cs with Hg, from which full calculations of the cross sections for the excitation cross sections and for the interaction of the excited species in the P-states can be performed. For Na-Hg three sets of potentials are given; the first one, together with K-Hg, Rb-Hg, and Cs-Hg, satisfies the measurements of the ground state interaction. The interaction of Na with Hg in the excited state was also investigated by measuring the differential cross section for a laser excited beam of Na. The potentials fitted to the ground state measurement will not quantita-

tively describe the interaction in the excited state. This is achieved with the potentials given as a second listing for Na-Hg. In this calculation however, the ground state is not accurately described. Therefore the third listing for Na-Hg gives a compromise which satisfies both the excited state and the ground state interaction as much as possible.

43926 Coherent-state multipole moments in electron-hydrogen impact excitation. Band, Y.B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **19**: No. 5, 1906-1920(May 1979).

We present results of various model calculations for the density-matrix elements of hydrogen excited by electron impact. These density-matrix elements are discussed in terms of expectation values of physically understandable observable multipole moment operators and their time derivatives, thereby enabling us to isolate and understand central features of the collision dynamics hidden in the off-diagonal density-matrix elements. The strengths and weaknesses of these various scattering models, including plane-wave Born, distorted-wave Born, Glauber, classical trajectory, quasiclassical close-coupling, and close-coupling approximations are pointed out. The effects of angular momentum barriers, the impulsive nature of excitation, the mixing and splitting of degenerate energy eigenstates of the final state manifold, and the various ranges and times of the interactions occurring durng the collision are described. We observe that perturbative scattering models are inappropriate to describe certain of these multipole, even at very high energies. Experiments which determine these multipole-moment parameters are discussed.

43927 Fluorescence quantum yields of isotopic CO_2^+ ions. Leach, S.; Devoret, M. (Paris-11 Univ., 91 - Orsay (France)); Eland, J.H.D. (Argonne National Lab., IL (USA)). *Chem. Phys. (Amsterdam);* **33**: No. 1, 113-121(1 Sep 1978).

Fluorescence quantum yields of the A ^{2}PIsub(u) and B $^2\Sigma^+$sub(u) states of the isotopic ions $^{12}C^{16}O^+_2$, $^{13}C^{16}O^+_2$ and $^{12}C^{8}O^+_2$, formed by 584 A photoionization of CO_2, have been measured by a photon-photoion coincidence technique. The corresponding 584 A photoelectron spectra, measured for $^{12}C^{16}O_2$ and $^{13}C^{16}O_2$, showed that the relative photoelectron branching ratios for forming the A ^{2}PIsub(u) and B $^2\Sigma^+$sub(u) states of CO^+_2 are isotope independent. The fluorescence quantum yields are greater than unity for the A ^{2}PIsub(u) state and less than unity for B $^2\Sigma^+$sub(u) for the three isotopic ions but the values are isotopic dependent, the difference from unity correlating with the degree of spectral perturbation in the B $^2\Sigma^+$sub(u) - X ^{2}PIsub(g)0^0_0 band. Calculations are made to identify the vibronic levels of A ^{2}PIsub(u) capable of interacting with the B $^2\Sigma^+$sub(u) (0,0,0) level. The discrepancy concerning the apparent population ratio of the A ^{2}PIsub(u) and B $^2\Sigma^+$sub(u) states of CO^+_2, formed by photoionization of CO_2, between the results of photoelectron spectroscopy and those of CO_2^+ ion fluorescence intensities explained as due to interelectronic state coupling. The effects of this discrepancy on the determination of cross sections for forming the B $^2\Sigma^+$sub(u) and A ^{2}PIsub(u) states by various excitation mechanisms are discussed.

43928 Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976). 474p. (CONF-750820—).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Emphasis of this collection of lectures is the study of ionization and excitation processes under photon and electron impact in the neutral free atom in the soft x-ray region. The chapters deal with photoionization and collision processes, neutral and ionic systems, as well as outer- and inner-shell excitations in a wide range of energy exchanges. Twenty-six individual abstracts were prepared for the data base. (GHT)

43929 Correlations of excited electrons. Fano, U. (Univ. of Chicago, IL). pp 11-30 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Inelastic collisions of an electron with an atom or molecule at energies within several eV of an excitation or ionization threshold, lead to the temporary formation of a complex whose available energy is shared in comparable amounts between the incident electron and the one being excited. Analogous complexes are formed when two electrons are excited simultaneously by incident light or by an analogous external agent. The properties of such complexes, including the rate and modality of their prompt or delayed decomposition, depend on the correlation of the two excited electrons. Their study is reviewed with emphasis on achieving a graphical description of the correlations. (GHT)

43930 Photoelectron spectrometry: experiments with atoms. Krause, M.O. (Oak Ridge National Lab., TN). pp 133-163 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

The technique of photoelectron spectrometry is reviewed and its capacity and potential to delineate the electronic structure and dynamics of atoms is outlined. Photoelectron spectrometric experiments that give evidence of many-electron interactions in atoms, are discussed with emphasis on experiments that are promising for future work on electron—electron correlation effects. (GHT)

43931 Theoretical aspects of electron correlations in electron collisions. Inokuti, M. (Argonne National Lab., IL). pp 165-185 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Electron-correlation effects manifest themselves in diverse facets of electron collisions with an atom or molecule. A fast incident electron acts largely as an external agent, and its inelastic collisions probe the structure, including correlations within the target (in both the initial state and the final state), nearly in the same way as photoionization processes do. In inelastic collisions of a slow electron, the central object of study is the correlated motion of the incident electron and an electron excited out of the target core. This elementary observation is illustrated in the lecture by many examples and is elaborated by remarks on some current theoretical methods.

ATOMIC AND MOLECULAR THEORY

43932 (LA-UR—79-1235) Atomic capture of negative mesons in hydrogen. Leon, M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

After a brief description of the present state of theoretical understanding of atomic capture of negative mesons, a very simple model calculation of negative muon capture by the simplest atoms, hydrogen is described. Also the possibility of generalizing these results to more complicated atoms and even molecules is noted. 15 references. (JFP)

43933 (LBL—9094) Selected topics on the electronic structure of small molecules. Swope, W.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 80p. Dep. NTIS, PC A05/MF A01.

Thesis.

A systematic procedure is presented for constructing symmetrized functions of the coordinates of N fermion particles which may be used as trial wavefunctions in a quantum mechanical description of an N-electron molecular system. The functions are symmetrized with respect to the mathematical point group of operators which commute with the system's electronic Born-Oppenheimer Hamiltonian, as well as the permutation group. The procedure is essentially the Clebsch—Gordan geneological coupling method (which is well-known from its application to the coupling of angular momenta) applied to the finite groups which describe the symmetry operations of a molecule. The coupling procedure is applied to the study of the electronic structure of several states of the diatomic molecule sulfur oxide. The advantage of the coupling procedure in this study is that it results in entirely real N-particle functions which are constructed from entirely real single-particle functions. The use of complex functions tends to be cumbersome from a computational point of view and should be avoided when possible. Also, a simple model is presented which provides insight into some of the electric and magnetic properties of small molecules. The probability distribution of the electrons in a molecule is approximated by that of a single particle moving in a three-dimensional anisotropic harmonic oscillator potential. Within this approximation the molecular electric polarizability, the magnetic susceptibility, and the magnetic shielding of a nuclear spin due to currents generated in the electron distribution by a magnetic field (the chemical shift) are computed using perturbation theory. The model exhibits Van Vleck paramagnetism for the last two properties. The predictions for the three properties provided by the model as applied to molecular hydrogen, H_2, are compared with experimental results.

43934 Ordering of atomic energy levels in excited states. Foley, H.M. (Physics Department, Columbia University, New York, New York 10025). *Phys. Rev., A;* **19**: No. 5, 2134-2136(May 1979).

A remarkably consistent ordering of excited atomic states with the quantity $k < n + l$, for small values of the orbital angular momentum l, was pointed out by Sternheimer. This fact is readily interpreted in terms of the variation of the quantum defects with l, and simple rules for the k ordering are given. The reasons for the observed variation of the quantum defects can be understood in terms of the accumulation of zero-energy scattering phase shifts with l and with Z, as calculated by Manson from a realistic atomic potential.

43935 Diagonal F/sup (4)/ and F/sup (6)/ coefficients for spherical-top molecules in angular-momentum states up to J = 100. Krohn, B.J. (Los Alamos Scientific Lab., NM). *J. Mol. Spectrosc.;* **68**: 497-498(1977).

A computer listing of the diagonal F^4 and F^6 coefficients of Moret—Bailly (Cah. Phys., 15: 237 (1961)) was prepared for 2 <- J <- 100, along with multiples of these quantitites that are convenient for fine structure analysis in P, Q, and R branches of fundamental-type bands in highly resolved spectra of spherical-top molecules. 5 references. (JFP)

43936 Multiple excitation in free molecules. Carlson, T.A. (Oak Ridge National Lab., TN). pp 343-353 of Photoionization and other probes of many-electron interactions. Wuilleumier, F.J. (ed.). New York, NY; Plenum Press (1976).

From Conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Multiple excitation in molecules offers a number of new challenging problems that are not found in atomic systems. In particular, there is the interesting question of the nature of electron shakeup as the result of producing a localized and non-central potential. In fact, are we correct in only assuming that monopole transitions occur? There is a strong need for extending fundamental studies in the general field of molecules, particularly in the area of theory. In addition, the investigation of strong shakeup satellites in complex molecules can be used to shed light on the nature of chemical bonding for these species.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 43618

43937 (LA-UR—79-4) **Systematic modeling rules for Reynolds stress closures in free-shear layers.** Mjolsness, R.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790624—1). Dep. NTIS, PC A02/MF A01.

From 21. annual ASME conference symposium on turbulent boundary layers; Niagara Falls, NY, USA (18 Jun 1979).

General modeling rules are proposed for constructing Reynolds stress closures. The rules require that the modeled terms in the evolution equations for R/sub ij/ be represented as a linear combination of certain permissible groups of terms. The rules severely restrict the number of permissible groups of terms. The permissible groups of terms include many, but not all, types of terms previously proposed for turbulence modeling via Reynolds stress closures. It is shown that a lack of experimental information prevents one from concluding that D/sub ij/ is proportional to δ/sub ij/ for well-developed turbulence, even though this assumption is commonly made. In consequence, onee does not know to which correlation tensor one should assign terms algebraic in R/sub ij/.

SUPERFLUIDITY

43938 (BNL—26168) **Fluctuations and freezing in a one-dimensional liquid: Hg/sub 3-δ/AsF$_6$.** Axe, J.D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 17p. (CONF-790487—2). Dep. NTIS, PC A02/MF A01.

From NATO advanced study Institute on ordering in strongly - fluctuating condensed - matter systems; Geilo, Norway (16 Apr 1979).

Many papers deal quite properly with systems at their critical dimensionality, d*. In such systems the competing forces between organization and disorder are nearly equally balanced and the analysis of the resulting situation requires some subtlety. Not surprisingly, the situation is somewhat simplified when the dimensionality falls below d*. For ordinary translational ordering of fluids (i.e., crystallization), d*=2. The properties of certain quasi-one-dimensional systems are explored, which since they are effectively below d*, resist the conventional crystalline order until abnormally low temperatures, and assume instead a state which is likened to a 1-dimensional liquid.

43939 Fifth sound in superfluid ^{4}He and ^{3}He-^{4}He mixtures. Williams, G.A.; Rosenbaum, R.; Rudnick, I. (Department of Physics, University of California, Los Angelos, California 90024). *Phys. Rev. Lett.;* **42**: No. 19, 1282-1285(7 May 1979).

A new thermal mode, fifth sound, has been observed in a superleak partially filled with superfluid helium. The velocity of the mode in ^{4}He and ^{3}He-^{4}He mixtures is in good agreement with the theoretical value $c_5^2 <$ (rho/sub n//rho) c_2^2. The index of refraction is found to be a strong function of the fractionsl filling of the superleak.

43940 Phase diagram and concentration susceptibility of ^{3}He—^{4}He mixtures near the tricritical point. Kierstead, H.A. (Argonne National Laboratory, Argonne, Illinois). *J. Low Temp. Phys.;* **35**: No. 1, 25-39(1 Apr 1979).

The inverse concentration susceptibility (partialphi/partialx)/ sub T/ of ^{3}He—^{4}He mixtures has been calculated from high-resolution vapor-pressure measurements and in situ measurements of the dielectric constant very close to the tricritical point. The measurements have been fitted to a scaling-law equation of state. In the normal fluid a logarithmic correction term was necessary to obtain a good fit. In the superfluid a regular correction term, proportional to (x—x@sub t@)^2, was evaluated. New measurements of the phase-separation curve confirm our earlier measurements on the ^{3}He-rich side and extend the measurements much closer to the tricritical point on the ^{4}He-rich side. The tricritical point is at temperature T<0.8669 +- 0.0005 K and mole fraction x<0.6716 +- 0.0014

43941 Spin waves in pulsed NMR experiments in the B phase of He^3. Fomin, I.A. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 334-336(20 Sep 1978).

The dispersion law of spin waves in the B phase of He^3 in a strong magnetic field is determined for arbitrary values of the initial angle between the magnetization and the field. Instability of the homogeneous precession is observed for a large class of initial conditions.

43942 Lifetime of roton in liquid helium. Blagoveshchenskii, N.M.; Dokukin, E.B. (Institute of High Pressure Physics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 363-366(20 Sep 1978).

The temperature dependence of the lifetime and energy of the roton was investigated by the method of inelastic scattering of neutrons. It follows from the results that the elementary theory of the roton lifetime in superfluid He^4 does not explain satisfactorily the Γ (T) dependence, and calls for invoking additional broadening mechanisms. Strong damping of the roton at the λ point was experimentally demonstrated.

HIGH ENERGY PHYSICS

43943 (DOE/ER—0027) **High energy physics. Ultimate structure of matter and energy.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Apr 1979. 42p. Dep. NTIS, PC A03/MF A01.

Some of the principle discoveries and insights and their development up to today are sketched. It is shown how one layer after another was discovered by penetrating farther into the structure of matter. Covered are the mounting energy scale, discoveries at high energy frontier, the families of quarks and leptons, the four forces of nature, some achievements of the past few years, particle accelerators and experimental apparatus. A glossary of terms is included.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

43944 (LBL—9017) **Electrons and kaons in charmed particle decays.** Feller, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1979. Contract W-7405-ENG-48. 145p. Dep. NTIS, PC A07/MF A01.

Thesis.

Inclusive studies of the electron content, kaon content, and associated electron-kaon content of the decays of D mesons and other charmed particles produced in electron-positron annihilation are presented. At the psi(3772) resonance the following inclusive branching ratios for D meson decays to charged kaons were measured. Also at the psi(3772) resonance the average semileptonic branching ratio for D^0 and D^+ decays to electrons has been measured to be .076 +- .028. The average semileptonic branching ratio of charmed particles produced in e^+e^- annihilation at center-of-mass energies from 3.9 to 7.4 GeV is found to be equal within errors to that of the D's. At all energies the electron momentum spectra are consistent with a combination of the decays D → Ke nu and D → K*e nu. 84 references.

43945 Measurement of the relative total hadronic cross section R at PETRA. Barber, D.; Becker, U.; Benda, H.; Boehm, A.; Branson, J.G.; Bron, J.; Buikman, D.; Burger, J.; Chang, C.C.; Chen, M.; Cheng, C.P.; Chu, Y.S.; Clare, R.; Duinker, P.; Fesefeldt, H.; Fong, D.; Fukushima, M.; Ho, M.C.; Hsu, T.T.; Kadel, R.; Luckey, D.; Ma, C.M.; Massaro, G.; Matsuda, T.; Newman, H.; Paradiso, J.;

Revol, J.P.; Rohde, M.; Rykaczewski, H.; Sinram, K.; Tang, H.W.; Ting, S.C.C.; Tung, K.L.; Vannucci, F.; White, M.; Wu, T.W.; Yang, P.C.; Yu, C.C. (III. Physikalisches Institut A. Rheinisch Westfaelische Technische Hochschule, Physikzentrum, Aachen, West Germany). *Phys. Rev. Lett.;* **42**: No. 17, 1113-1117(23 Apr 1979).

We report the first measurement of the ratio R < (σ/sub e/+/sub e/-@sub tsarrow-righttshadrons@)/(σ/sub e/+/sub e/-@sub tsarrow-righttsmu@+/sub μ/-) (with negligible tau-lepton contribution) at a center-of-mass energy √s < 13 GeV and √s < 17 GeV, from the just finished electron-positron colliding-beam facility PETRA. The detector, MARK-J, has an approximately 4π solid angle and measures γ,e,μ, and charged and neutral hadrons simultaneously. Our results yield R (√s < 17 GeV) < 4.9 +- 0.6 (statistical) +- 0.7 (systematic error), and R (√s < 13 GeV) < 4.6 +- 0.5 (statistical) +- 0.7 (systematic error). The ratio R (√s < 17 GeV)/R (√s < 13 GeV) is 1.08 +- 0.18.

43946 Four-body semi-leptonic decay rates of charmed baryons. Fernandez Pacheco, A.; Grifols, J.A. (Stanford Linear Accelerator Center, CA (USA)); Ferreira, E.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil)). *Lett. Nuovo Cim.;* **20**: No. 9, 303-307(29 Oct 1977).

The semileptonic decay rates for the Λsub(c)sup(+) charmed baryon into final states with two hadrons and a lepton pair are estimated. It is found that these rates are of magnitude comparable to the semileptonic modes into three particles.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 43953

43947 (COO—3071-238) **Measurement of the y-distributions in antineutrino inelastic interactions with nucleons.** Benvenuti, A.; Bobisut, F.; Cline, D. (Fermi National Accelerator Lab., Batavia, IL (USA); Harvard Univ., Cambridge, MA (USA). Dept. of Physics; Ohio State Univ., Columbus (USA). Dept. of Physics; Pennsylvania Univ., Philadelphia (USA). Dept. of Physics; Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Physics; Wisconsin Univ., Madison (USA). Dept. of Physics). 1978. Contract EY-76-C-02-3071. 18p. (CONF-780453—13). Dep. NTIS, PC A02/MF A01.

From Neutrinos; West Lafayette, IN, USA (28 Apr 1978).

Preliminary results are presented on the y-distributions in anti ν reactions obtained in a recent high acceptance counter experiment (E310) at Fermilab. The data show an energy dependence of dN/dy on E-/sub nu/ from 10 to 200 GeV. The y-distributions at low values of x are much flatter than at higher x, implying a different density of antiquarks at different x. A summary of world data on y-distributions is also presented. 10 references.

43948 Measurement of the elastic scattering of neutrinos and antineutrinos by protons. Entenberg, A.; Horstkotte, J.; Kozanecki, W.; Mann, A.K.; Rubbia, C.; Strait, J.; Sulak, L.; Wanderer, P.; Williams, H.H. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **42**: No. 18, 1198-1201(30 Apr 1979).

We have observed 217 (66) events of the process νp → νp (nu-barp → nu-barp) with an estimated background of 82 (28). The neutral-to-charged—current ratios are σ (νp → νp)/σ (νn → μ⁻p) < 0.11 +- 0.02 and σ (nu-barp → nu-barp)/σ (nu-barp → μ⁺n) < 0.19 +- 0.05 for 0.40 < Q^2 < 0.90 (GeV/c)², where -Q^2 is the square of the momentum transfer to the nucleon. These yield σ (nu-barp → nu-barp)/σ (νp → νp) < 0.53 +- 0.17. The neutral-current form factors at Q^2 < 0 are G/sub E/ < 0.5@sup +0.25@@sub -0.5@, G/sub M/ < 1.0@sup +0.35@@sub -0.04@, and g/sub A/ < 0.5@sup +0.2@@sub -0.15@.

43949 Measurement of the decay rate for the process K⁰/sub L/ → μ⁺μ⁻. Shochet, M.J.; Linsay, P.; Grosso-Pilcher, C.; Frisch, H.J.; DeVoe, R.; Cronin, J.W.; Moffett, D.R. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Phys. Rev., D;* **19**: No. 7, 1965-1977(1 Apr 1979).

The branching ratio Γ (K⁰/sub L/ → μ⁺μ⁻)/Γ (K⁰/sub L/ → π⁺π⁻) has been measured and found to be 4.0@sup +1.4@@sub -0.9@ x 10⁻⁶. With the same apparatus the branching ratio Γ (K⁰/sub L/ → π⁺π⁻)/Γ (K⁰/sub L/ → all) has been measured to be (2.01 +- 0.09) x 10⁻³. The combination of these two results gives Γ (K⁰/sub L/ → μ⁺μ⁻)/Γ (K⁰/sub L/ → all) < 8.1@sup +2.8@@sub -1.8@ x 10⁻⁹. This result is consistent with the lower bound predicted from the decay rate K/sub L/ → γγ and unitarity.

43950 Use of Δphi-angle test to rule out neutral heavy leptons. Albright, C.H.; Smith, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **19**: No. 7, 2204-2206(1 Apr 1979).

The strong energy dependence of the Δphi distribution signal for neutrino production of neutral heavy leptons is pointed out in an effort to clarify the use of these distributions to suggest or rule out the existence of such leptons.

43951 Tau heavy lepton - a recently discovered elementary particle. Perl, M.L. (Stanford Linear Accelerator Center, CA (USA)). *Nature (London);* **275**: No. 5678, 273-278(28 Sep 1978).

This review recounts the history of the discovery of the tau heavy lepton. Evidence for the tau being a lepton is summarised and the known properties of the tau are discussed. 30 references.

STRONG BARYON-INDUCED INTERACTIONS

43952 (BNL—25057) **Session A5: hadron spectroscopy, experimental.** Ozaki, S. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 89p. (CONF-780826—31). Dep. NTIS, PC A05/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

Reports 55 contubutions made by mini-rapporteurs and individual contributors are assembled. It is clear, from the contributions made to this session, that there has been steady progress in solving the problem of the hadron spectroscopy of the old style. The picture on the scalar mesons has become clearer. Among the vector meson group, we started to understand Q mesons, though the situation with A_1 is still not clear. Mesons with higher spin have been found and, in some cases, confirmed. In a sense, the jigsaw puzzle on the mesons is gradually being completed while more complex features are found. The same can be said on the baryons. An active study is in progress in the experiment on the exotic states such as narrow baryonium and dibaryon states. However, owing to the difficulty of such experiments and interpretation of the data, a definitive result is yet to come. 94 references.

43953 (BNL—26056) **Observation of the kaonic decay of the Λ/sub c/⁺ charmed baryon.** Cnops, A.M.; Connolly, P.L.; Kahn, S.A.; Kirk, H.G.; Murtagh, M.J.; Palmer, R.B.; Samios, N.P.; Tanaka, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 9p. (CONF-790365—1). Dep. NTIS, PC A02/MF A01.

From 16. rencontre de moriond; Les Arcs, Savoie, France (17 Mar 1979).

There were 34 events observed with visible strange particle production out of a total charged current sample of 4,500 events in a wide-band neutrino exposure of the BNL 7-foot bubble chamber filled with H_2 or D_2. Three events were uniquely identified as having single strange particle production, two with ΔS = -ΔQ. In both ΔS = -ΔQ events we observe the Λ/sub c/⁺(2260), which in one case decays to $\Lambda\pi^+\pi^+\pi^-$ and in the second case to panti $K^0\pi^-\pi^+$. Production rates are given. 11 references.

43954 (COO—4064-1) **For continuation of support for theoretical studies and analysis of data on high multiplicity gamma ray events produced in p-p collisions at the CERN ISR.** Dooher, J. (Adelphi Research Center, Inc., Garden City, NY (USA)). 8 Feb 1979. Contract EY-76-S-02-4064. 85p. Dep. NTIS, PC A05/MF A01.

Experimental and theoretical research on pp interactions is summarized. (JFP)

43955 (LA—7733-T) **Elastic neutron-proton differential cross section at 647 MeV.** Evans, M.L. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 176p. Dep. NTIS, PC A09/MF A01.

The differential cross section for n-p elastic scattering in the angular range 51 < θ /sub cm/ < 180° was measured with high statistical accuracy using the 647 MeV monoenergetic neutron beam of the Los Alamos Meson Physics Facility. A proton recoil magnetic spectrometer was used for momentum analysis of the charge exchange protons from the reaction n+p→p+n. Absolute normalization of the cross section was established to within 7% using existing cross section data for the reaction p+p→π⁺+d. The results differ significantly from previous Dubna and PPA cross sections but agree well with recent Saclay data except at extreme backward angles. 41 references.

43956 Differential ranges and angular distributions of Ba fragments from the interaction of ^{238}U with 11.5-GeV protons. Porile, N.T.; Pandian, S.; Klonk, H.; Rudy, C.R.; Steinberg, E.P. (Department of Chemistry, Purdue University, W. Lafayette, Indiana 47907). *Phys. Rev., C;* **19**: No. 5, 1832-1842(May 1979).

Angular distributions and differential ranges at 90° to the beam direction have been measured for the following products from the interaction of ^{238}U with 11.5-GeV protons: ^{128}Ba, ^{131}La, ^{131}Ba (independent), ^{135}Ba/sup m/, and ^{140}Ba. All the angular distributions peak at sideward angles. A two-parameter (n@sub parallel@ and b/a) fit to the angular distributions based on the two-step model yields an anisotropy parameter, b/a, of ~ -0.2 for all products. The value of <v@sub parallel@>, the mean forward component of velocity of the struck nuclei, is also insensitive to the composition of the observed products. A sharp transition in the momentum spectra derived from the differential ranges is observed just over one Z unit to the neutron-deficient side of stability. Products on the neutron-

rich side of this transition have narrow, symmetric spectra, with mean values of ~ 130 (MeV A)@sup 1/2@, that are characteristic of fission. Products on the neutron deficient side have broad, asymmetric spectra, with a mean value of only ~ 70 (MeV A)@sup 1/2@, as expected for a deep spallation mechanism. The spectrum of independently formed ^{131}Ba, which lies in the transition region, was decomposed into fission and deep spallation contributions, with the latter accounting for most of the cross section.

43957 Jets produced in π^-, π^+, and proton interactions at 200 GeV on hydrogen and aluminum targets. Bromberg, C.; Fox, G.; Gomez, R.; Pine, J.; Rohlf, J.; Stampke, S.; Yung, K.; Erhan, S.; Lorenz, E.; Medinnis, M.; Schlein, P.; Ashford, V.; Haggerty, H.; Juhala, R.; Malamud, E.; Mori, S.; Abrams, R.; Delzenero, R.; Goldberg, H.; Margulies, S.; McLeod, D.; Solomon, J.; Stanek, R.; Dzierba, A.; Kropac, W. (California Institute of Technology, Pasadena, California 91125). *Phys. Rev. Lett.;* **42**: No. 18, 1202-1206(30 Apr 1979).

This paper presents results from an experiment on the production of jets (groups of particles) with high p@sub perpendicular@ produced in 200-GeV/c interactions. Results are presented on the comparison of jet cross sections on aluminum and hydrogen targets. The jet fragmentation distributions are also examined. Both the cross section and the jet structure are found to depend strongly on the beam and target types.

43958 Two-particle quantum-number correlations in 400-GeV/c proton-nucleus collisions. Finley, D.A.; Ditzler, W.R.; Johnson, O.E.; Loeffler, F.J.; Shibata, E.; Akerloff, C.W.; Alley, P.; Fabrizio, R.; Koltick, D.; Meyer, D.I.; Thun, R.; Bintinger, D.; Loveless, R.L.; Lundy, R.A.; Stanfield, K.C.; Yovanovitch, D.D. (Purdue University, West Lafayette, Indiana 47907). *Phys. Rev. Lett.;* **42**: No. 16, 1028-1031(16 Apr 1979).

We have measured two-particle quantum-number correlations in 400-GeV/c proton-nucleus collisions. A double-arm spectrometer was used to detect two charged particles produced near rapidity y@sub c.m.@ < -0.4 in the proton-nucleon center-of-mass system. In proton-beryllium collisions we observe positive pp-bar and K^+K^- correlations which are independent of the transverse momenta of the particles over the range 1 < or = p@sub perpendicular@ < or = 1.8 GeV/c. These correlations are weaker in proton-lead interactions.

43959 Nucleon-number dependence of inclusive dihadron production in proton-nucleus collisions at 400 GeV/c. Finley, D.A.; Ditzler, W.R.; Johnson, O.E.; Loeffler, F.J.; Shibata, E.; Akerlof, C.W.; Alley, P.; Fabrizio, R.; Koltick, D.; Meyer, D.I.; Thun, R.; Bintinger, D.; Loveless, R.L.; Lundy, R.A.; Stanfield, K.C.; Yovanovitch, D.D. (Purdue University, West Lafayette, Indiana 47907). *Phys. Rev. Lett.;* **42**: No. 16, 1031-1034(16 Apr 1979).

We have measured the nucleon-number (A) dependence of hadron-pair production in 400-GeV/c proton-nucleus collisions, using Pb and Be targets. Charged-hadron pairs were observed near rapidity y@sub c.m.@ < -0.4 with $\Delta\phi \cong 180°$. The A-dependence exponent rises from 1.1 to 1.2 in the range 2.0 < or = vertical-barp@sub perpendicular@1vertical-bar + vertical-barp@sub perpendicular@2vertical-bar < or = 4.5GeV/c. The dihadron p@sub perpendicular@ correlation function is significantly smaller for Pb than for Be.

43960 Study of low-mass p-barp pairs. Carroll, A.S.; Chiang, I.; Kycia, T.F.; Li, K.K.; Littenberg, L.; Mazur, P.O.; de Brion, J.P.; Carithers, W.C. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **19**: No. 7, 1950-1954(1 Apr 1979).

A search as been conducted for narrow structures in the p-barp mass spectrum from threshold to 2700 MeV/c^2 in a production experiment on a beryllium target in a neutral beam. Mass spectra of the K^+K^- and K^-p states have also been extracted from the data, and known resonances have been used to check the mass resolution. With a sample of 8393 p-barp pairs, no statistically significant narrow structures have been observed.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 43952

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

43961 (COO—3533-136) **Research program in elementary particle theory. Progress report ending June 30, 1980.** (Syracuse Univ., NY (USA). Dept. of Physics). 1980. Contract EY-76-S-02-3533. 39p. (SU—4213-136). Dep. NTIS, PC A03/MF A01.

The work on Dual Topological Unitarization was continued with special emphasis on its relation to QCD. Several unified gauge models for weak and electromagnetic interactions were investigated. The problem of maintaining technically natural T and P conservation in gauge theory models for strong interactions as well as the axion problem were studied in detail. In the past, non-linear models have been successful in explaining strong interactions at low energies. However, they have not until now been regarded as gauge theories. They were formulated so they became gauge theories as well. Their relation to Gribov ambiguities was also shown. The Lorentz force equation for point particles was generalized to extended objects coupled to gauge fields. The interaction of two widely separated 't Hooft-Polyakov monopoles for arbitrary gauge groups and Higgs multiplets was explored. The path integral quantization of Dirac's monopole Lagrangian was carried out. The spatial symmetry properties of multi-instanton configurations were investigated. Techniques for the computation of certain 3j coefficients were developed.

GENERAL

43962 Action-principle quantization of the antisymmetric tensor field. Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Phys. Rev., D;* **19**: No. 8, 2367-2369(15 Apr 1979).

It is shown that the quantization of the antisymmetric tensor gauge field can readily be effected by straightforward application of the action principle. In particular, the correct number of constraint equations is found for both the massive and massless cases. When a coupling to the Maxwell field is included the two polarization states of the latter are seen to combine with the one degree of freedom of the antisymmetric tensor to yield a massive vector field.

43963 Jet structure in e^+e^- meson production. Kitazoe, T.; Hama, S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **19**: No. 7, 2006-2017(1 Apr 1979).

We consider an alternative to the usual parton picture, introducing "lightlike" (zero mass) quarks. The "lightlike" character of the quarks results from a strong Lorentz contraction of the outcoming meson Bethe-Salpeter amplitudes in $e^+e^- \rightarrow n\pi$ reactions. Two jets are produced which have the correct angular dependence only if one of the two jets contains a vector meson. The meson momenta are strongly ordered and the longitudinal-momentum distribution has an equal spacing in the scaling variables log(2P/sub i/parallel/$\sqrt{s}$). The upper bound of the cross section and the maximal multiplicity are calculated and found to be consistent with experiment.

43964 Behavior of transport coefficients at relativistic temperatures. Gangnus, Y.S.; Prozorkevich, A.V.; Smolyanskii, S.A. (Saratov State University). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 347-349(20 Sep 1978).

It is shown qualitatively that allowance for the dissipative effects can turn out to be substantial when it comes to describing earlier stages of the evolution of the universe and in the hydrodynamic theory of multiple production of particles.

ELECTROMAGNETIC INTERACTIONS

43965 Rates and properties of trimuon events observed in high-energy neutrino interactions. Benvenuti, A.; Bobisut, F.; Cline, D.; Cooper, P.S.; Gilchriese, M.G.D.; Heagy, S.M.; Imlay, R.; Ling, T.Y.; Mann, A.K.; McIntyre, P.; Mori, S.; Reeder, D.D.; Rich, J.; Stefanski, R.; Trinko, T.; Winn, D.R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **42**: No. 16, 1024-1027(16 Apr 1979).

We report on 39 trimuon events observed in high-energy neutrino interactions at Fermilab. The observed trimuon rate relative to single-muon production is $(1.1 \pm 0.5) \times 10^{-4}$ for E/sub ν/ > 100 GeV. The properties of the trimuons are consistent with those for electromagnetic and direct production of muon pairs, although the production of charm-anticharm pairs may account for approximately 20% of the observed rate. New heavy leptons or heavy quarks do not contribute significantly.

43966 Light-quark masses and isospin violation. Gross, D.J.; Treiman, S.B.; Wilczek, F. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev., D;* **19**: No. 7, 2188-2196(1 Apr 1979).

Isospin-violating effects arising from a nonvanishing quark mass difference m/sub d/-m/sub u/ are discussed, in particular for the π^+-π^0 mass difference question and for eta' $\rightarrow 3\pi$ and $\Sigma \rightarrow \Lambda + e + \nu$ decays. The role of the strong anomaly is emphasized, and exploited to bring out certain relations among heavy-quark,light-quark, and gluon operator matrix elements. The anomaly suppresses isospin-violating effects that might otherwise be substantial for the Bjorken electroproduction sum rule.

43967 Radiative transitions of baryons in the MIT bag. Hey, A.J.G.; Holstein, B.R.; Sidhu, D.P. (Physics Department, Southamp-

ton University, England). *Ann. Phys. (N.Y.);* **117**: No. 1, 5-18(Jan 1979).

Resonance photoproduction is studied via the MIT bag model and comparison is made with a single quark transition SU (6)/sub w/ analysis. Correspondence is found between the two pictures. The bag model predictions are shown to be in good qualitative agreement with experiment; however, specific numerical results are rather model dependent and in general less successful.

WEAK INTERACTIONS

43968 K⁰ bold-arrow-left-right K-bar⁰ transition amplitude in the MIT bag model. Shrock, R.E.; Treiman, S.B. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). *Phys. Rev., D;* **19**: No. 7, 2148-2157(1 Apr 1979).

Estimates of the K⁰ bold-arrow-left-right K-bar⁰ transition amplitude and the resulting K/sub L/K/sub S/ mass difference are often based on an effective-Lagrangian treatment, where L@sub eff@ is taken to be the four-quark operator extracted from a lowest-order calculation of the free-quark s-bar + d → s + d-bar scattering amplitude. For conventional SU(2) x U(1) models this effective Lagrangian has the form of a (V-A) current-current interaction O/sub J/J, with coefficient C parametrized by quark masses and mixing angles. An important question has to do with gluonic and other corrections to the coefficient, but, independent of this, it is also necessary to estimate the matrix element of O/sub J/J between physical K⁰ and K-bar⁰ states. We focus on this aspect of the problem. Earlier treatments have relied on a "vacuum-insertion" approximation. For an alternative approach, we employ the static MIT bag model. With the standard values for the bag parameters the matrix element is smaller than that obtained with vacuum insertion by about a factor of 2. This result is reasonably stable for small variations of the bag parameters.

STRONG INTERACTIONS, GENERAL

43969 (FERMILAB-CONF—78/75-THY) **Particle production from nuclear targets and the structure of hadrons.** Bialas, A. (Fermi National Accelerator Lab., Batavia, IL (USA); Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki). Sep 1978. 20p. (CONF-780788—5). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on high energy multiparticle dynamics; Tabor, Czechoslovakia (2 Jul 1978).

Production processes from nuclear targets allow the study of interactions of elementary hadronic constituents in nuclear matter. The information thus obtained on the structure of hadrons and on the properties of hadronic constituents is presented. Both soft (low momentum transfer) and hard (high momentum transfer) processes are discussed. 89 references.

43970 Connection between quark-model eigenstates and low-energy scattering. Jaffe, R.L.; Low, F.E. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., D;* **19**: No. 7, 2105-2118(1 Apr 1979).

We propose a new method of analyzing low-energy hadron-hadron scattering designed to reveal internal quark-gluon eigenstates. Our method is a modification of the Wigner-Eisenbud formalism suited to the case of confining boundary conditions. We have identified a matrix function of the energy (which we call P) whose poles and residues correspond to the masses and channel projections of quark-gluon eigenstates calculated with spherical bag boundary conditions. To illustrate the formalism we apply it to the low-energy S-wave scattering of pseudoscalar mesons. We find from the data clear evidence of internal states corresponding to quark-model predictions of $Q^2Q\text{-bar}^2$ states at 0.69 and 1.04 GeV in the I < 0 channel, at 0.96 GeV in the I < 1/2 channel, at 1.19 GeV in the I < 3/2 channel, and at 1.04 GeV in the I < 2 channel. We believe the I < 3/2 and 2 internal states to be the low-energy exotics long predicted by quark models.

43971 Chiral solitons and current algebra. Pak, N.K.; Tze, H.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Ann. Phys. (N.Y.);* **117**: No. 1, 164-194(Jan 1979).

We investigate the possiblity of a realistic hadrodynamics based solely on observable currents. The basic idea is to exploit the soliton generation in bosonic chiral theories as a mechanism for finding the fermionic representations of current algebra. A prototype realization is Skyrme's O (4) invariant theory of pions and nucleons. A comprehensive reexamination of this model in the context of chiral dynamics suffices to reveal a strikingly self-consistent dynamical picture. First a differential geometric formulation gives the proper framework for a chiral invariant quantum theory of solitons and allows a compact derivation of Skyrme's main results. While no exact analytic solution is found, the solitons are sufficiently localized so that their singularities can be properly isolated out for analysis. Using W itten's ansatz, a determination of the form of the 1-soliton singularity is obtained from the field equations. It is given by Cayley's steoreographic projection from S^3 to $R^3 \{\infty\} \cong S^3$, and a most suitable form for the proof of spinor structure. Williams' proof that the quantized 1-soliton sector gives rise to fermionic spin states is recalled. It is argued that the topological dynamics of this sector induce an invariance group K < SU (2)/sub I/ x SU (2)/sub J/ and its associated strong coupling isobaric spectrum for the nucleons. The associated current algebra is derived and resolves the main difficulties of the Sugawara—Sommerfield program. The signature of a field theoretical bootstrap is clear: massive nucleons as soliton bound states of Nambu—Goldstone bosons illustrate a dynamical mechanism dual to that of Nambu and Jona-Lasinio.

43972 New approach to the hydrodynamic theory of multiple production of hadrons. Gorenshtein, M.I.; Zinov'ev, G.M.; Sinyukov, Y.M. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 343-346(20 Sep 1978).

An approach that makes it possible to find the dynamic connection between the characteristics of the leading particles and the behavior of the spectra of secondary pions is developed on the basis of scaling solutions of the hydrodynamic theory of multiple production. Explanations are offered for the experiments on long-radius correlation forces, and a correspondence is noted between the considered space-time picture of multiple processes and the quark-parton concepts.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 43979

43973 Four-quark model for the mesons. Brayshaw, D.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **42**: No. 17, 1106-1109(23 Apr 1979).

A four-quark mechanism is proposed which generates virtually the entire known spectrum of (noncharm) meson states to remarkable accuracy. The ground-state 0^- and 1^- nonets are taken as input; exclusive of octet-singlet mixing there are no free parameters.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 43954

43974 Crucial spin tests of quantum-chromodynamic approaches to large-transverse-momentum processes. Chen, C.K. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **19**: No. 7, 2119-2122(1 Apr 1979).

The polarization of the large-p/sub T/ reaction p + p → π + X is shown to vanish if the perturbative quantum-chromodynamical approach is used. The status of two-spin correlation studies of large-p/sub T/ inclusive production processes is clarified, the usefulness of spin correlations of the reaction p + p → $\pi^+ + \pi^+$ + X in revealing the nature of constituent scattering is discussed, whereas the reaction p + p → π + X is less useful for this purpose.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

43975 Natural suppression of strong P- and T-invariance violations and calculable mixing angles in SU(2) x U(1). Segre, G.; Weldon, H.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev. Lett.;* **42**: No. 18, 1191-1195(30 Apr 1979).

Permutation symmetry is imposed on an SU(2)/sub L/ x U(1) x CP-invariant Lagrangian with six quarks. The mixing angles of the b and t are determined: b decays predominantly to u and a meson containing b should have a lifetime tau/sub B/ ≅ 10^{-11} sec or less. A phase in the gauge couplings of b and t causes nonconservation of CP in K/sub L/ decays that is naturally small. No violations of P and T invariance are induced into the strong interactions by phi < arg(DetM) at the tree level. One-loop corrections yield an upper bound of phi < 10^{-10}(m/sub s//m/sub b/)(m/sub t//m/sub b/)^2.

43976 Lie-group explanation of geometric interpretations of solitons. Sym, A.; Corones, J. (Department of Mathematics, Iowa State University, Ames, Iowa 50011). *Phys. Rev. Lett.;* **42**: No. 17, 1099-1102(23 Apr 1979).

This paper presents a group-theoretic explanation of the geometric interpretation of solitons due to Lamb and Lund.

43977 Exact SU(N) monopole solutions with spherical symmetry. Wilkinson, D.; Bais, F.A. (Fermi National Accelerator Laboratory,

Batavia, Illinois 60510). *Phys. Rev., D;* **19**: No. 8, 2410-2415(15 Apr 1979).

Exact monopole solutions are constructed for an SU(N + 1) gauge theory spontaneously broken by a single Higgs field in the adjoint representation. The solutions saturate the Bogomolny lower bound on the energy and are spherically symmetric with respect to the angular momentum operator J < -ir x del-arrow-right + T, where T generates the maximal SU(2) subalgebra of SU(N + 1). Our solutions are the most general ones with the above symmetry and contain N real parameters which may be thought of as specifying the nature of symmetry breaking. When this symmetry breaking is such that the scalar field matrix has repeated eigenvalues, it is found that only one of the possible point monopoles has a corresponding finite-energy solution saturating the Bogomolny bound.

43978 List of grand unification gauge groups. Hacinliyan, A.; Saclioglu, C. (Department of Physics, Bogazici University, Bebek, Istanbul, Turkey). *Phys. Rev., D;* **19**: No. 8, 2440-2446(15 Apr 1979).

We present a method for constructing the grand unification gauge group G (of the type G or G/sup P/, where G is simple) corresponding to a given subgroup G@sub flavor@ x G@sub color@. The essence of the method is to count the leptoquarks and diquarks by generating the latter through Pauli-Guersey transformations, to add that number to that of the generators of G@sub flavor@ x G@sub color@, and to compare the result with various possible G's via Diophantine equations. Specifically, we take G@sub color@ < SU(3), or SU(4) with leptons representing the fourth color in the second case. For the flavor group, we consider generalizations of essentially all the examples of flavor groups proposed so far, subject to the constraints of lepton-quark flavor universality and an upper limit of 16 quark flavors so as not to destroy asymptotic freedom. The resulting system of roughly 200 Diophantine equations is easily numerically solved. After eliminating a large number of spurious solutions by matching the ranks of G@sub flavor@ x G@sub color@ and G, we exhibit the remaining grand unification candidates. The Georgi-Glashow SU/sub L/(2) x U(1) x SU/sub C/(3) ⊃ SU(5) is found to be a special case of SU/sub L/(n) x U(1) x SU(3) ⊃ SU(n + 3). The Fritzsch-Minkowski SO(10), the Segre-Weldon SU(6), and Guersey-Ramond-Sikivie E_6, E_7 models are recovered alongside a surprisingly small number of new possibilities. In particular, no semisimple unifying group of the form G/sup P/ is found for 2 < or = P < or = 4. Finally, our results and methods are compared with those of a recent review on the same subject.

FIELD THEORY

REFER ALSO TO CITATION(S) 43977

43979 (LA-UR—79-1102) **Field theoretic extensions of TDHF techniques.** Campbell, D.K. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 12p. (CONF-790545—1). Dep. NTIS, PC A02/MF A01.

From Time-dependent Hartree-Fock international workshop; Gif-sur-Yvette, France (28 May 1979).

A possible extension of time-dependent Hartree-Fock (TDHF) techniques to relativistic quantum field theories is discussed. A set of extended TDHF equations which incorporates naturally relativistic kinematics and treats the mesons, the effects of which are in ordinary TDHF represented by a nonindependent mean field, as independent dynamical degrees of freedom. In a simple model field theory in one space and one time dimension the extended TDHF equations are solved analytically for certain static field configurations and numerically for the time-dependent scattering configuration. Qualitative features of the scattering solutions as observed in preliminary numerical studies are discussed, and the conclusion is reached by mentioning a number of problems for further research. 22 references.

43980 Partially conserved axial-vector current and model chiral field theories in nuclear physics. Campbell, D.K. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **19**: No. 5, 1965-1970(May 1979).

We comment on the relation between the two standard approaches to chiral symmetry—namely, the current algebra/partially conserved axial-vector current approach and the chiral Lagrangian method—in a manner intended to clarify recent and probable future applications of this symmetry in nuclear physics. Specifically, we show that in explicit chiral field theories the canonical πN scattering amplitude does not have the famed "Adler zero" unless partial conservation of axial-vector current holds as an operator equation. This implies that there are a number of familiar chiral models in which the "Adler self-consistency" condition does not apply to the canonical pion field. Among the problems of current interest for which our remarks are relevant are the studies of the pion-nucleus optical potential, pion condensation, and the attempts to formulate a model field theory having both reasonable nuclear saturation and good low energy pion phenomenology.

43981 Conformal gravity as a gauge theory. Mansouri, F. (Department of Physics, Yale University, New Haven, Connecticut 06520). *Phys. Rev. Lett.;* **42**: No. 16, 1021-1024(16 Apr 1979).

It is shown that the same two features that determine the structure of ordinary gravity and supergravity theories also determine the structure of conformal gravity. The relevant local gauge symmetry turns out to be the inhomogeneous Weyl group. The transformation laws of the fields follow from geometry. Some consequences of breaking the scale symmetry are briefly discussed.

43982 Local field theory for solitons. II. Bardakci, K. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., D;* **19**: No. 8, 2357-2366(15 Apr 1979).

A method previously developed for constructing field theories of solitons is extended to non-Abelian vortex models in (2 + 1) dimensions and to both Abelian and non-Abelian models in (3 + 1) dimensions. In (2 + 1) dimensions, a local field theory is obtained, and in (3 + 1) dimensions, string theories with local interaction emerge. Various features of these models are investigated.

43983 Scale breaking for quark and gluon distributions in quantum chromodynamics: A diagrammatic analysis. Frazer, W.R.; Gunion, J.F. (Department of Physics, B-019, University of California, San Diego, La Jolla, California 92093). *Phys. Rev., D;* **19**: No. 8, 2447-2467(15 Apr 1979).

We demonstrate that, in an appropriately chosen axial gauge, the leading contributions to the scale breaking of quark and gluon distributions in quantum chromodynamics arise from fully renormalized ladder graphs. These may be conveniently summed using the Bethe-Salpeter equation and reproduce the standard results obtained via the operator-product-expansion—renormalization-group analysis. The diagrammatic analysis makes it clear that scale breaking (from the two-particle reducible ladder graphs) of the distributions is universal and factorizes, in any parton-model application, from the short-distance (two-particle irreducible) "subprocess." In addition, the dominance of ladder diagrams can be used to justify the Altarelli-Parisi approach to scale breaking including a demonstration that their infrared regularization scheme arises naturally when quark and gluon wave-function renormalization is properly included.

SCATTERING THEORY

REFER ALSO TO CITATION(S) 43979

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

43984 (DOE/ER—01388-345) **Nuclear Physics Laboratory 1976 annual report.** (Washington Univ., Seattle (USA). Nuclear Physics Lab.). Jun 1976. Contract EY-76-C-06-1388. 201p. (RLO—1388-345). Dep. NTIS, PC A10/MF A01.

Laboratory activities for the period spring, 1975 to spring, 1976 are described. The emphasis of the work can be discerned from the chapter headings: accelerator development; ion source development; instrumentation, detectors, research techniques; computer and computing; atomic physics; nuclear astrophysics; fundamental symmetries in nuclei; nuclear structure; radiative capture measurements and calculations; scattering and reactions; reactions with polarized protons and deuterons; heavy-ion elastic and inelastic scattering; heavy-ion deeply inelastic and fusion reactions; heavy ion transfer and intermediate structure reactions; medium-energy physics; and energy studies. Research by users and visitors is also described; and laboratory personnel, degrees granted, and publications are listed. Those summaries having significant amounts of information are indexed individually. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 43986

43985 Photonuclear cross sections for ^{18}O. Woodworth, J.G.; McNeill, K.G.; Jury, J.W.; Alvarez, R.A.; Berman, B.L.; Faul, D.D.;

Meyer, P. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **19**: No. 5, 1667-1683(May 1979).

All the major photonuclear cross sections for ^{16}O, including σ (γ,p), $\sigma[(\gamma,n) + (\gamma,np)]$, and σ $(\gamma,2n)$, were measured as a function of photon energy from threshold to 42 MeV. The photon energy resolution was between 200 and 300 keV. The source of radiation was the monoenergetic photon beam obtained from the annihilation in flight of fast positrons. The partial photoneutron cross sections were determined by neutron multiplicity counting, and the average neutron energies for both single- and double-photoneutron events were determined simultaneously with the cross-section data by the ring-ratio technique. The photoproton cross section was determined by counting the delayed neutrons from the β-decay of the residual ^{17}N nuclei. Integrated cross sections were extracted from the data and compared with sum-rule predictions. Resonances in the pygmy-resonance region exhibit substantial decay branching to negative-parity states in ^{17}O. Significant differences in the branching of resonances in the giant-resonance region to the various partial cross sections, together with the photoneutron-energy data, allow isospin assignments to be made for all the resonances, with the consequent delineation of the isospin strength distribution for ^{16}O. Evidence was found for two weak but broad resonances above the giant-resonance region. Finally, comparison with the corresponding cross sections for ^{16}O shows considerable differences between the two nuclei.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

43986 (UCRL—50400(Vol.21)(Pt.A)) **Integrated system of production of neutronics and photonics calculational constants. Volume 21, Part A. Maxwell-averaged reaction rates (sigma v-bar) for selecteed reactions between ions with atomic mass ≦ 11.** Howerton, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1979. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Maxwell-averaged reaction rates (sigma v-bar) are presented for 24 interactions between ^{1}H, ^{2}H, ^{3}H, ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, ^{10}B, and ^{11}B ions. The reactions rates are calculated by use of the evaluated data of the LLL Evaluated Nuclear Data Library (ENDL). 5 figures, 5 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

43987 (UCRL—82570) **Identification of the isovector giant quadrupole resonance in ^{16}O via the ^{16}O (γ,n_0).** Phillips, T.W.; Johnson, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Apr 1979. Contract W-7405-ENG-48. 3p. (CONF-790610—1). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

In order to identify the quadrupole transition strength in ^{16}O, angular distribution measurements were made at six angles simultaneously at 25 to 44 MeV. The magnitude of the cross section relative to the deuteron photodisintegration cross section and the resultant cross section and Legendre expansion coefficients for the angular distribution are displayed. The nonzero coefficients indicate the presence of mixed parity transitions with multipole moments greater than 1. (JFP)

43988 **Photoneutron cross sections for ^{13}C.** Jury, J.W.; Berman, B.L.; Faul, D.D.; Meyer, P.; McNeill, K.G.; Woodworth, J.G. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., C;* **19**: No. 5, 1684-1692(May 1979).

The photoneutron cross sections for ^{13}C have been measured from near threshold to over 40 MeV using monoenergetic photons from positron in-flight annihilation. Several sharp features below the giant resonance were distinguished. The results both for this "pygmy-resonance" region and for the giant resonance near 24 MeV differ markedly from previously reported measurements and provide a much better quantitative comparison with recent theoretical calculations of the photoneutron reaction in ^{13}C. Comparison of the measured total photoneutron cross section with recent data on the ground-state photoreaction and with average photoneutron energies provides evidence for the isospin splitting of the giant resonance for this nucleus.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 43987, 44020

43989 (DOE/ER—01388-345, pp 66-71) **Isospin mixing in ^{12}C.** Adelberger, E.G. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Data on radiative widths and spectroscopic factors for ^{12}C levels are tabulated. It is shown that the magnitude for isospin mixing in the 1^+ doublet is much smaller than previously reported. 2 figures, 1 table. (RWR)

43990 (DOE/ER—01388-345, pp 80) **$^{11}B(p,\gamma)^{12}C$ reaction.** Noe, J.; Paul, P.; Snover, K.A.; Suffert, M.; Warburton, E.K. (Brookhaven National Lab., Upton, NY). Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Measurements were made from 21 to 29 MeV. Integrated cross sections are shown as are angular distribution Legendre coefficients, as a function of bombarding energy from 5 to 30 MeV. Calculations including direct E2 and direct plus collective E1 contributions provide a good fit to the data. 1 figure. (RWR)

43991 (DOE/ER—01388-345, pp 81-83) **$^{11}C(p$ vector,$\gamma)^{15}N$ reaction.** Bussoletti, J.E.; Ebisawa, K.; Snover, K.A.; Trainor, T.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Measured and calculated angular distribution coefficients are shown from 9 to 18 MeV. Relative E1 amplitudes and phases for the reaction are plotted, as are the E2 amplitude ratio (p/f) and phase differences. The 90° excitation function and sigma /sub E2/ are exhibited. 4 figures, 1 table. (RWR)

43992 (DOE/ER—01388-345, pp 123-124) **Elastic scattering of ^{14}N by ^{12}C from 33.0 to 48.0 MeV.** Chan, Y.D.; Cuengco, B.; Cramer, J.G.; Liu, K.L. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Excitation functions for 12 to 26 MeV (c.m.) are shown for 43.5, 54.5, 130, and 140°. The optical model did not reproduce the data. Hauser—Feshbach and LCNO calculations of the angular distributions are compared with the data at 33.0, 38.0, 41.0, 44.0, and 46 MeV (lab.). It is concluded that several reaction mechanisms may give equally strong contributions. 2 figures. (RWR)

43993 (DOE/ER—01388-345, pp 125-127) **Elastic scattering of ^{16}O from ^{14}C.** Bernhardt, K.G.; Eberhard, K.A.; Vandenbosch, R.; Webb, M. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Excitation functions over the energy range 15 to 30 MeV (c.m.) are presented. Comments are made on the reaction mechanism. 1 figure. (RWR)

43994 (DOE/ER—01388-345, pp 139-143) **Study of excitation functions for ^{16}O and ^{18}O induced reactions on ^{12}C using γ-ray spectroscopy.** Bernhardt, K.G.; Bohn, H.; Chan, Y.D.; Cramer, J.G.; Green, L.; Sielemann, R.; Vandenbosch, R. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Gamma spectra are shown for bombarding energies of about 9.5 MeV (c.m.), and identifications of the various lines are made. The relative cross section of the $2^+ \rightarrow 0^+$ and $4^+ \rightarrow 2^+$ gamma transition intensity in ^{24}Mg is shown as a function of center-of-mass energy in the $^{12}C + {}^{16}O$ system. 2 figures. (RWR)

43995 (DOE/ER—01388-345, pp 149-151) **Studies of the reactions $^{12}C(^{14}N,{}^{13}N)^{13}C$ and $^{12}C(^{14}N,{}^{13}C)^{13}N$ at 53.5 MeV.** Bangert, R.; Chan, Y.D.; Cramer, J.G.; Cuengco, B.; Liu, K.L.; Lynch, W.; Wiborg, J. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

A typical energy spectrum is shown. The elastic scattering angular distribution was fitted with the optical model. The transfer reaction angular distributions are compared with results of DWBA calculations. 4 figures. (RWR)

43996 (DOE/ER—01388-345, pp 152-155) **$^{12}C + {}^{16}O \rightarrow {}^{8}Be + {}^{20}Ne$ reaction.** Bernhardt, K.G.; Bohn, H.; Eberhard, K.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Excitation functions from 14 to 24 MeV (c.m.) are presented at several angles for the $^{12}C(^{16}O,{}^{8}Be)^{20}Ne$ and $^{12}C(^{16}O,\alpha)^{24}Mg$ reactions. Angle-integrated and energy-averaged excitation functions and state- and angle-integrated cross correlation functions are also given. 3 figures. (RWR)

43997 (DOE/ER—01388-345, pp 156-157) **$^{12}C(^{18}O,\alpha)^{26}Mg$ reaction.** Bernhardt, K.G.; Eberhard, K.A.; Vandenbosch, R.; Webb, M.P. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

The angular distribution is shown for 19.0 MeV (c.m.). The deviation function is shown for the reaction and also elastic scattering. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 44041

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44040

43998 **Rotational-energy contributions to the kinetic energies of deep-inelastic reaction products.** Betts, R.R.; DiCenzo, S.B. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06520). *Phys. Rev., C;* **19**: No. 5, 2070-2072(May 1979).

The extraction of rotational contributions to the energies of deep-inelastic fragments from light systems is discussed. It is concluded that the data are consistent with the occurrence of scission at the critical radius as well as at the large radii previously suggested.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

43999 (DOE/ER—01388-345, pp 93-95) **Excitation functions and angular distributions for inelastic ^{4}He scattering to the (0^{+}, 6.44 MeV) state in ^{24}Mg.** Bernhardt, K.G.; Blair, J.S.; Bohn, H.; Cramer, J.G.; Cuengco, B.; Sielemann, R. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Angular distributions for elastic and inelastic scattering at 22.3, 22.5, 22.7, 22.9, and 23.5 MeV are shown, along with the excitation function at 35°. 2 figures. (RWR)

44000 (DOE/ER—01388-345, pp 109-111) **Evidence for shallow strongly absorbing heavy-ion optical potentials.** Cramer, J.G.; DeVries, R.M.; Goldberg, D.A.; Zisman, M.S. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Elastic scattering of ^{16}O from ^{28}Si was measured at 215.2 MeV and analyzed with the optical model along with data down to 33 MeV. A well depth of 10 MeV was preferred over one of 100 MeV. 1 figure, 1 table. (RWR)

44001 (DOE/ER—01388-345, pp 127-128) **Elastic scattering of ^{28}Si from ^{26}Mg.** Bangert, R.; Chan, Y.D.; Cramer, J.G.; Liu, K.L.; Gelbke, C.K.; Wiborg, J. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

The angular distribution at 80 MeV is shown along with an optical potential fit. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

44002 (DOE/ER—01388-345, pp 128-133) **Effects of non-local potentials in heavy ion reactions.** Cramer, J.G.; DeVries, R.M.; Lynch, W.G. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

The effect of Perey damping on a DWBA calculation of the ^{42}Ca(^{16}O,^{15}N)^{43}Sc* reaction at 48 MeV is shown for a strongly absorbing potential and a weakly absorbing potential. The optical-model parameters used are discussed. 2 figures. (RWR)

44003 (DOE/ER—01388-345, pp 158-162) **Total pion cross-sections.** Halpern, I.; Knutson, L. (Los Alamos Scientific Lab., NM). Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Calculated cross-section differences for pions on ^{48}Ca and ^{40}Ca at 50 to 250 MeV are shown. In the region of the (3,3) resonance, a 0.1F change in the value of the rms radius difference r/ sub n/-r/sub p/ in ^{48}Ca results in a 40 mb (4%) change in its total cross section for negative pions. The corresponding change for positive pions is about 16 mb. 1 figure. (RWR)

44004 **Neutron isotopic density differences deduced from 0.8 GeV polarized proton elastic scattering.** Ray, L. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **19**: No. 5, 1855-1872(May 1979).

The microscopic spin-independent proton-nucleus optical potential defined by Kerman, McManus, and Thaler is used to analyze recent 0.8 GeV polarized proton elastic scattering data from @sup 40,48@Ca, @sup 58,64@Ni, @sup 116,124@Sn, and ^{208}Pb. Second-order effects due to target nucleon correlations are included in both the central and spin-orbit parts of the proton-nucleus optical potential. Electromagnetic corrections to the proton density which arise from the electric and magnetic form factors of the neutron, and from the magnetic form factor of the proton, are also calculated. A discussion is presented regarding uncertainties in the nucleon-nucleon amplitudes used in construction of the potential, and also discrete ambiguities which arise from fitting the limited set of nucleon-nucleon data available near 1 GeV are examined. Approximately model-independent forms are assumed for the target neutron density distributions, thereby allowing the statistical and model-dependence errors to be estimated. Neutron density and rms radii are deduced and compared to Hartree-Fock predictions, with good agreement found for most of the seven nuclei studied. Because of the uncertainty in the proton-nucleon amplitudes, neutron density and radius differences are considered more reliable than individual absolute values. Owing to the inclusion of certain second-order terms discussed here, an accurate determination of these differences is obtained.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

44005 (LA-UR—79-1043) **Nuclear charge radii of the 1f/sub 7/2/ shell nuclei from muonic atoms.** Wohlfahrt, H.D. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-790528—1). Dep. NTIS, PC A02/MF A01.

From International discussion meeting about what do we know about radial shape of nuclei in the Ca region; Karlsruhe, F.R. Germany (2 May 1979).

The studies reported include all stable 1f/sub 7/2/ neutron shell nuclei, and provide information about the proton core polarization due to the successive addition of neutrons for the proton cores Z = 20, 22, 24, 26, and 28. These studies, which represent the first systematic investigations of isotone shifts, also provide the opportunity to compare the core polarization caused by protons with that caused by neutrons in the same shell. An interpretation of the observed systematics is given. 12 figures, 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44029

44006 (DOE/ER—01388-345, pp 51-52) **Gamma-ray production cross sections.** Bodansky, D.; Chiang, D.; Dyer, P. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Gamma ray yields from the p + ^{56}Fe reaction from 5 to 15 MeV are shown. Gammas of 0.847, 1.238, and 1.811 MeV come from inelastic scattering, while those of 0.812 MeV come from the (p,n) reaction. 1 figure. (RWR)

44007 (DOE/ER—01388-345, pp 118-122) **Elastic and inelastic scattering of ^{6}Li by ^{40}Ca and ^{44}Ca.** Bangert, R.; Bernhardt, K.G.; Bohn, H.; Chan, Y.D.; Eberhard, K.A.; Vandenbosch, R. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Angular distributions at 30 MeV were analyzed by use of the optical model for elastic scattering and coupled-channel calculations for inelastic scattering. Optimal-model parameters are tabulated. The angular distribution for the ^{40}Ca(^{6}Li,^{4}He) reaction is also shown. 3 figures, 1 table. (RWR)

44008 (LA—7802-MS) **Production of iron nuclides in thermal, fission, and 14.1-MeV neutron sources.** MacInnes, M.R.; Kantelo, M. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

The ^{56}Fe(n,2n)^{55}Fe, ^{54}Fe(n,p)^{54}Mn, and ^{54}Fe(n,α)^{51}Cr cross sections at 14.1 MeV were measured. Also determined was the production of n,γ, n,p, and n,α reactions on iron due to degraded fission neutrons and n,γ production on iron in a thermal neutron source.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

REFER ALSO TO CITATION(S) 44004

RADIOACTIVE DECAY

44009 **Levels in @sup 78,80,82@As from the @sup 78,80,82@Se(t,^{3}He) reactions.** Ajzenberg-Selove, F.; Flynn, E.R.; Hanson, D.L.; Orbesen, S. (Department of Physics, University of

Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev., C;* **19**: No. 5, 1742-1746(May 1979).

Levels of the neutron rich arsenic isotopes are studied by the Se(t,^{3}He)As reactions. In ^{78}As, 33 levels up to E/sub x/ < 2383 keV are identified. In @sup 80,82@As where no levels have previously been assigned, 18 and 9 levels respectively were observed. A mass excess of -72182 +- 20 keV is obtained for ^{80}As which disagrees substantially with recent β-decay measurements. For ^{82}As the measured mass excess is -70067 +- 27 keV which differs by 300 keV from previous measurements.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 44009

NUCLEAR REACTIONS AND SCATTERING

44010 (DOE/ER—01388-345, pp 105-108) **Analyzing powers for the continuum portions of particle emission spectra.** Bhang, H.; Halpern, I.; Liu, K.L.; Lynch, W.; Tsang, B.; Trainor, T.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Typical spectra from the reactions ^{63}Cu(p,p') and ^{63}Cu(p,α) with polarized protons at 14 and 18 MeV are shown. Analyzing powers are tabulated. Small but finite values were measured in the higher-energy portions (and perhaps even in the evaporation portions) of the continuum emission spectra. 1 figure, 1 table. (RWR)

44011 (DOE/ER—01388-345, pp 176-178) **^{89}Y(p,γ)^{90}Zr reaction below the giant dipole resonance.** Berghofer, D. (Univ. of British Columbia, Vancouver); Hasinoff, M.; Helmer, R.; Lim, S.T.; Measday, D.; Trainor, T.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Coefficients obtained by fitting gamma angular distributions to a Legendre polynomial expansion are plotted. The asymmetry produced in the gamma radiation when the reaction is initiated by polarized protons was measured, and the results are tabulated. The total E2 photodisintegration cross section corresponding to 4.2, 4.8, 6.15, and 6.8 MeV proton energy was obtained by applying detailed balance to the capture cross sections. 1 figure, 1 table. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 44004, 44040

MASS, ABUNDANCE, AND BINDING ENERGY

44012 **Mass and excited states of ^{100}Nb.** Ajzenberg-Selove, F.; Flynn, E.R.; Hanson, D.; Orbesen, S. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Phys. Rev., C;* **19**: No. 5, 2068-2069(May 1979).

The ^{100}Mo(t,^{3}He)^{100}Nb reaction has been used to determine the mass and the energy levels of ^{100}Nb. A mass excess of -79480 +- 30 keV is obtained for ^{100}Nb, in substantial disagreement with β-decay results. Twenty-two excited states of ^{100}Nb with E/sub x/ < 1.3 MeV have been observed.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 44012

44013 **Population of intrinsic high spin states with the direct ^{116}Sn(α,p)^{119}Sb reaction.** Smith, P.A.; Emigh, R.A.; DiGiacomo, N.J.; Smith, G.R.; Peterson, R.J. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80309). *Phys. Rev., C;* **19**: No. 5, 1767-1774(May 1979).

The ^{116}Sn(α,p)^{119}Sb reaction at E/sub b/ < 35.6 MeV has been used to locate previously unknown high spin states in ^{119}Sb. Cluster distorted-wave Born-approximation calculations have been employed to identify L < 10 (J/sup [/ < 19/2$^+$, 21/2$^+$) transfers to states at 4.120 +- 0.015 and 4.210 +- 0.015 MeV. A state located at 4.020 +- 0.015 MeV may be fit by either L < 12 or 14 distorted-wave Born-approximation curves. These high spin states are not members of the previously identified K/sup [/ < 9/2$^+$ rotational band. No evidence for population of this 9/2$^+$ band was observed. Residual interaction matrix elements for the (νh@sub 11/2@πs@sub 1/2@)$_{5-6}$ configurations have been deduced, assuming simple wave functions for the states populated by L < 10 transfers. The resulting matrix elements are in excellent agreement with the predictions of a δ force, as are other matrix elements extracted from the odd-odd Sb spectra.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44011, 44016, 44018

44014 (LA—7808-MS) **Coupled neutron and photon cross sections for transport calculations.** Barrett, R.J.; MacFarlane, R.E. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

A compact set of multigroup cross sections and transfer tables for use in neutron and photon transport calculations was prepared from ENDF/B-IV using the NJOY processing system. The library includes prompt and steady-state coupled sets for neutrons and photons in FIDO format, prompt and steady-state fission spectra (chi vectors) for the fissionable isotopes, and a table of useful response functions including heating and gas production. These multigroup constants should be useful for a wide variety of problems where self-shielding is not important. 15 references.

44015 (ORO—4936-4) **Nuclear spectroscopic studies.** Bingham, C.R.; Riedinger, L.L.; Guidry, M.W. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1 Mar 1979. Contract EY-76-S-05-4936. 49p. Dep. NTIS, PC A03/MF A01.

A summary of experimental research on nuclear reactions on intermediate mass nuclei and their structure is presented. A list of publications is included. 23 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 44015

44016 (BNL—26098) **Spectroscopy of heavy nuclei: yrast states, side bands and backbending.** Sunyar, A.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 18p. (CONF-790323—5). Dep. NTIS, PC A02/MF A01.

From Symposium on high spin phenomena in nuclei; Argonne, IL, USA (15 Mar 1979).

Some recent experimental results concerning the high spin structure of two rare earth nuclei are presented. These are ^{154}Er and ^{158}Dy. The level schemes including yrast sequences are discussed. The reactions ^{142}Nd(^{16}O,4n) and ^{150}Nd(^{13}C,5n) respectively, for the studied nuclei are noted. 14 references. (JFP)

44017 (DOE/ER—01388-345, pp 72-75) **Lifetimes of isomeric states in ^{174}Hf.** Bohn, H.; Chan, Y.D.; Ejiri, H.; Sielemann, R. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Measured half-lives for gamma rays of 0.188, 0.353, 0.941, and 1.252 MeV are tabulated; and the transitions are located in the level scheme. 1 figure, 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44016

44018 (DOE/ER—01388-345, pp 144-148) **Kr and Xe induced reactions.** Thomas, T.D. (Oregon State Univ., Corvallis); Vandenbosch, R.; Webb, M.P. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Singles energy spectra and angular distributions are shown for ^{86}Kr + ^{139}La at 710 MeV; the reaction mechanism is discussed. Energy spectra for the ^{208}Pb + ^{136}Xe reaction at 1120 MeV are given. The triple-differential cross section for the ^{136}Xe + ^{181}Ta reaction at 1120 MeV is shown as a function of Z. 6 figures. (RWR)

44019 (RLO—2227/T35-1, pp 55-59) **Radioanalytical studies of product mass and charge distributions in the reaction of 25 GeV ^{12}C with Ta.** 1978.

In Nuclear chemistry progress report, December 1, 1977—September 1, 1978.

44020 (UCRL—78482(Suppl.)) **Atlas of photoneutron cross sections obtained with monoenergetic photons .** Berman, B.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1979. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

The data included in this supplement replace earlier preliminary results presented in the Bicentennial Edition of the Atlas of Photoneutron Cross Sections (UCRL-78482, 1976). The nuclei included are ^{13}C, ^{19}O, ^{55}Mn, ^{59}Co, $^{186\ 188\ 189\ 192}$Os, ^{232}Th, and $^{235\ 236\ 238}$U, all from measurements performed at Lawrence Livermore Laboratory.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

44021 (DOE/ER—01388-345, pp 88-91) **Direct—semidirect calculation in the Pb region.** Ebisawa, K; Snover, K.A. Jun 1976. In Nuclear Physics Laboratory 1976 annual report.

Direct—semidirect radiative capture theory was applied to proton capture by ^{205}Tl and ^{206}Pb, where the isovector giant quadrupole resonance is expected to be near 23 MeV. The energy dependence of sums and differences of cross sections at 55° and 125° is shown from 7 to 25 MeV. The total cross section for neutron capture by ^{208}Pb is also exhibited. 3 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

RADIOACTIVE DECAY

44022 (DOE/ER—01388-345, pp 48-49) **K-shell ionization in α decay vs α collisions.** Bangert, R.; Burch, D.; Roth, M. Jun 1976. In Nuclear Physics Laboratory 1976 annual report.

Ionization during alpha decay of ^{210}Po and α + ^{206}Pb scattering was investigated. A collision/decay ratio of 1.96 +- 0.17 was found. Disagreement with the theoretical value of 4 indicates that coherent interference is not occurring in the theoretically predicted manner for the α collision. 2 figures. (RWR)

ENERGY LEVELS AND TRANSITIONS

44023 (DOE/ER—01388-345, pp 75-79) **Study of low lying dipole states in Pb isotopes via analog resonant (p,p'γ).** Chiang, D.; Cramer, J.G.; Dickey, P.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

On- and off-resonance coincidence spectra in ^{206}Pb, ^{207}Pb, ^{208}Pb are compared with elastic photon scattering cross section data. Ground-state branching ratios are tabulated for ^{208}Pb. 2 figures, 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44015, 44018, 44020

44024 (DOE/ER—01388-345, pp 102-104) **Analyzing power in the ^{207}Pb(p vector,p$_0$)^{207}Pb reaction near the 3p/sub 1/2/ isobaric analog resonance.** Back, N.L.; Bhang, H.C.; Cramer, T.G.; Lynch, W.G.; Trainor, T.A. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

The energy dependence from 11.1 to 12.1 MeV proton energy is shown for laboratory angles of 105, 120, and 135°. The structure due to the resonance at 11.53 MeV is clearly seen. Resonance parameters used to fit the data are tabulated. Analyzing power angular distributions (30 to 160°) were measured at 10.0 and 13.00 MeV. 3 figures, 1 table. (RWR)

44025 (RLO—2227/T35-1, pp 62-66) **Product mass and charge distributions in the interaction of relativistic protons with Ta, Au, U.** 1978.

In Nuclear chemistry progress report, December 1, 1977—September 1, 1978.

The product mass distribution is shown for the reaction of 11.5-GeV protons with Au. Work on other targets is in progress.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

SPONTANEOUS AND INDUCED FISSION

44026 (LA-UR—79-1306) **Distribution of nuclear charge and angular momentum in chains 132-137, 99, and 102 of thermal neutron fission of ^{235}U at various kinetic energies and charge states of the fragments.** Denschlag, H.O.; Braun, H.; Wolfsberg, K. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 34p. (CONF-790507—5). Dep. NTIS, PC A03/MF A01.

From IAEA symposium on physics and chemistry of fission; Julich, F.R. Germany (14 May 1979).

The fission product yields of the members of the decay chains 132 to 137, 99, and 102 in ^{235}U(n/sub th/,f) were measured at various kinetic energies and ionic charge states of the fragments using the mass separator for unslowed fission products LOHENGRIN. The results are discussed with respect to four aspects: A preferential formation of neutron rich chain members found at high kinetic energy of the fragments is predominantly due to decreasing prompt neutron evaporation. A particularly large effect in chain 132 is attributed to the double shell closure in Sn-132. The persistence of an even-odd pairing effect in the yields throughout the range of kinetic energies studied leads to the conclusion that the high internal excitation energy of the fragments is tied up mainly in the form of collective energy (e.g., deformation energy) rather than single particle excitation. Generally, the yield distribution at constant kinetic energy is invariant with respect to the ionic charge state of the isotopes separated. Deviations from this behavior found in chains 99, 102, 133, and 136 are interpreted as being due to Auger events following a converted transition in the decay of ns-isomers taking place in the vacuum of the separator. A pronounced variation of the independent formation ratio of single isomeric states with the kinetic energy of the fragments is providing direct information on the controversial topic of the change of angular momentum of fission fragments as a function of deformation (scission distance). 34 references.

44027 **Dependence of neutron yield on fragment mass for several low-energy fissioning systems.** Gindler, J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., C;* 19: No. 5, 1806-1819(May 1979).

Neutron-yield functions for ^{245}Cm(n,f), ^{252}Cf(sf), ^{254}Cf(sf), ^{254}Es(n,f), and ^{256}Fm(sf) are derived with an iterative method in which successive approximations to the pre-neutron-emission (initial) mass distribution are compared with the post-neutron-emission (final) mass distribution. Initial mass distributions are deduced from kinetic energy measurements of the fragments. Final mass distributions are determined from radiochemical measurements of fission product mass yields. The ^{252}Cf(sf) neutron-yield function so derived agrees well with functions determined directly by neutron counting. All neutron-yield functions exhibit a saw-toothed character. The masses for which maximum neutron emission occurs and for which minimum neutron emission occurs are within +- 2 mass units of being complementary masses for the observed fissioning system, with the exception of the ^{245}Cm(n,f) reaction. The effect of the neutron-yield function on various mass and energy correlations deduced from kinetic energy measurements is discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

44028 (CONF-790533—1) **Report on the IAEA coordinated research program on the measurement and evaluation of transactinium isotope nuclear decay data.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 31p. Dep. NTIS, PC A03/MF A01.

From 2. IAEA Advisory Group meeting on transactinium isotope nuclear data; Cadarache, France (2 May 1979).

As one result of the First IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, held in November 1975 at Karlsruhe, an IAEA Coordinated Research Program was set up to address certain identified actinide-isotope decay-data needs in reactor technology. At present, laboratories from five nations are involved in this effort. This paper gives an overview of this program, including its origin and the present status of the measurements being carried out. The current status of the actinide-nuclide half-life, spontaneous-fission branching ratio, α-intensity and γ-intensity data of concern to the Coordinated Research Program is presented and briefly discussed. 3 figures, 9 tables.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 44028

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 44020

44029 (PB—283522) **Benchmark experiments to test plutonium and stainless steel cross sections. Topical report.** Jenquin, U.P.; Bierman, S.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract DOE-EY-76-C-06-1830. 65p. NTIS PC A04/MF A01.

The Nuclear Regulatory Commission (NRC) commissioned Battelle, Pacific Northwest Laboratory (PNL) to ascertain the accuracy of the neutron cross sections for the isotopes of plutonium and the constituents of stainless steel and determine if improvements can be made in application to criticality safety analysis. NRC's particular area of interest is in the transportation of light-water reactor spent fuel assemblies. The project was divided into two tasks. The first task was to define a set of integral experimental measurements

(benchmarks). The second task is to use these benchmarks in neutronics calculations such that the accuracy of ENDF/B-IV plutonium and stainless steel cross sections can be assessed. The results of the first task are given in this report. A set of integral experiments most pertinent to testing the cross sections has been identified and the code input data for calculating each experiment has been developed.

44030 (RLO—2227/T35-1, pp 19-30) **Superheavy elements—a crossroads.** 1978.

In Nuclear chemistry progress report, December 1, 1977—September 1, 1978.

Recent attempts to synthesize super-heavy elements (SHE) through heavy-ion fusion are tabulated. Problems with these attempts are noted, and then the $^{48}Ca + {}^{248}Cm$ reaction is discussed in more detail. Cross sections are estimated, and it is concluded that present detection methods are not adequate to detect any SHE produced in the reaction. 1 figure, 2 tables. (RWR)

44031 (UCRL—50400(Vol.17)(Pt.E)) **Program EVALPLOT (Version 79-1): plot data in the Evaluated-Nuclear-Data File/Version B (ENDF/B) format.** Cullen, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1979. Contract W-7405-ENG-48. 86p. Dep. NTIS, PC A05/MF A01.

Program EVALPLOT is designed to plot evaluated cross sections in the ENDF/B format. The program plots cross sections, angular distributions, energy distributions, and parameters (e.g., μ-bar, xi-bar, and ν-bar). 16 figures, 2 tables.

44032 **New isotope ^{242}Bk.** Williams, K.E.; Seaborg, G.T. (Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Phys. Rev., C;* **19**: No. 5, 1794-1800(May 1979).

A new isotope of berkelium has been identified through bombardments of ^{235}U with ^{11}B, ^{238}U with ^{10}B, and ^{232}Th with both ^{14}N and ^{15}N. The new activity decays by electron capture with a half-life of 7.0 +- 1.3 minutes. The α-branching ratio for this isotope is less than 1% and that for spontaneous fission is less than 0.03%. Analysis of the excitation functions, the chemical behavior of the isotope, and the milking of the ^{242}Cm daughter leads to the positive identification of this isotope as ^{242}Bk. A preliminary search was made for ^{241}Bk but was unsuccessful. Examination of the (heavy ion, pxn) (Cm) and (heavy ion, αxn) (Am) transfer products in comparison with the (heavy ion, xn) (Bk) compound nucleus products produced in the above reactions revealed transfer reaction cross sections to be equal to or greater than the compound nucleus cross sections. The data suggest that in some cases the yield of an isotope produced via a pxn or αxn transfer reaction might be higher than its production via an xn compound nucleus reaction.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 44028

44033 (LA-UR—79-1082) **Fission properties of very heavy actinides.** Hoffman, D.C. (Los Alamos Scientific Lab., NM (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-36. 29p. (CONF-790507—4). Dep. NTIS, PC A03/MF A01.

From IAEA symposium on physics and chemistry of fission; Julich, F.R. Germany (14 May 1979).

The existing data on neutron-emission, kinetic-energy and mass distributions, and half-lives for spontaneous fission of the heavy actinides are reviewed. A comparison of the data for the Fm isotopes with heavier and lighter nuclides suggests that the properties of the heavy Fm isotopes may be unique and can qualitatively be explained on the basis of fragment shell effects, i.e., symmetric fission results in two fragments with configurations close to the doubly magic ^{132}Sn nucleus. The effect of excitation energy and the use of systematics and theoretical predictions of fission properties and half-lives in the identification of new heavy element isotopes is discussed. 54 references.

44034 (RLO—2227/T35-1, pp 73-76) **Studies of relativistic heavy ion induced fission: fission fragment charge distributions.** 1978.

In Nuclear chemistry progress report, December 1, 1977—September 1, 1978.

Independent yield iodine production cross sections from the interaction of relativistic projectiles with ^{238}U are shown. Projectiles were 25-GeV ^{12}C and 8-GeV ^{20}Ne.

44035 (RLO—2227/T35-1, pp 77-81) **Studies of relativistic heavy ion induced fission: fragment angular distributions.** 1978.

In Nuclear chemistry progress report, December 1, 1977—September 1, 1978.

The fission fragment angular distribution from the interaction of 21-GeV ^{20}Ne with ^{238}U is given. 1 figure. (RWR)

44036 (UCRL—81888) **Spontaneous fission of ^{259}Md.** Hulet, E.K.; Wild, J.F.; Lougheed, R.W.; Baisden, P.A.; Landrum, J.H.; Dougan, R.J.; Mustafa, M.; Ghiorso, A.; Nitschke, J.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 May 1979. Contract W-7405-ENG-48. 18p. (CONF-790507—6). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on physics and chemistry of fission; Julich, F.R. Germany (14 May 1979).

The mass and kinetic energy distributions of fission fragments from the spontaneous fission of th newly discovered nuclide ^{259}Md were obtained. ^{259}Md was identified as the E. C. daughter of ^{259}No, and was found to decay entirely (> 95%) by spontaneous fission with a 95-min half-life. From the kinetic energies measured for 397 pairs of coincident fragments, a mass distribution was derived that is symmetric with σ = 13 amu. ^{259}Md, together with ^{258}Fm and ^{259}Fm, form a select group of three nuclides whose mass division in spontaneous fission is highly symmetric. Unlike the total-kinetic-energy (TKE) distributions of ^{258}Fm and ^{259}Fm, which peak at approx. = to 240 MeV, this distribution for ^{259}Md is broad and is 50 MeV lower in energy. Analysis of the mass and energy distributions shows that events near mass symmetry also exhibit a broad TKE distribution, with one-third of the symmetric events having TKEs less than 200 MeV. The associated of low TKEs with symmetric mass division in the fission of very heavy actinides is anomalous and inconsistent with theories based upon the emergence of fragment shells near the scission point. Either three-body fragmentation or peculiar fragment shapes are assumed as the cause for the large consumption of Coulomb energy observed for a significant fraction of symmetric fissions in ^{259}Md. 6 figures.

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 43969, 43980

44037 (IS-M—201) **Effective interactions: derivation of moment criteria.** Dalton, B.J. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 9p. (CONF-790348—3). Dep. NTIS, PC A02/MF A01.

From Conference on the p,n reaction and the nucleon-nucleon force; Telluride, CO, USA (29 Mar 1979).

The derivation of moment criteria from the spectral criteria for the effective interaction is described, and a method is discussed for imposing the moment criteria to find the effective Hamiltonian. The motivation for this significantly different approach is the numerically demonstrated fact that the average shell model spectrum (level density) calculated in a finite basis is very near a Gaussian in shape. 18 references. (JFP)

44038 **Time-dependent coupled-cluster approximation to nuclear dynamics. II. General formulation.** Hoodbhoy, P.; Negele, J.W. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev., C;* **19**: No. 5, 1971-1982(May 1979).

A general formulation is presented of the time-dependent coupled-cluster hierarchy of equations introduced previously. Truncations appropriate to potentials with strongly repulsive cores are specified and the properties of the resulting equations of motion are discussed.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 43980

NUCLEAR REACTIONS AND SCATTERING

44039 (DOE/ER—01388-345, pp 115-118) **Notch perturbation tests of the sensitivity of the heavy ion optical model to the details of the nuclear potential.** Cramer, J.G. Jun 1976.

In Nuclear Physics Laboratory 1976 annual report.

Chi-square was calculated for $^{16}O + {}^{28}Si$ elastic scattering at 33, 53, and 215.2 MeV. Sensitivity functions are shown as a function of the radius and discussed. 3 figures. (RWR)

44040 (UCRL—82665) **Properties of multistep amplitudes in charge-exchange reactions.** Madsen, V.A.; Brown, V.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 19p. (CONF-790348—2). Dep. NTIS, PC A02/MF A01.

From Conference on the p,n reaction and the nucleon-nucleon force; Telluride, CO, USA (29 Mar 1979).

A historical review is given on what is known about inelastic multistep processes in analog charge-exchange transitions at lower energies in the few tens of MeV, particularly the possibility of

measuring directly with the (p,n) reaction the isovector deformation parameter. Then the expected energy dependence of multistep relative to one-step processes is shown, and an attempt is made to explain the behavior. The proton reactions on ^{92,100}Mo showing the analog ratio and the differential cross sections at 26 MeV and a listing of the energy dependence of the analog and analog cross sections and the two-step mechanism for analog excitation are presented. 16 references. (JFP)

NUCLEAR MODELS

44041 (CONF-790348—4) **Role of the n—p interaction in microscopic calculations of collective motion.** McGrory, J.B. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From Conference on the p,n reaction and the nucleon-nucleon force; Telluride, CO, USA (29 Mar 1979).

A topic of longstanding interest in nuclear structure theory has been the microscopic theory of collective nuclear behavior. There is now a large body of evidence that nuclear shell-model calculations can reproduce rotational behavior which is observed in light nuclei, particularly in the sd shell. The so-called interacting boson model which has been able to describe both rotational and vibrational behavior in intermediate and heavy nuclei, is a truncation scheme for shell-model calculations. An intrinsic assumption of the model is that the shell model is capable of describing observed collective phenomena. Recent papers have suggested that the neutron—proton interaction plays a decisive role in shell-model descriptions of rotational behavior. These arguments on the importance of n—p interaction are summarized. 6 figures, 4 tables. (RWR)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 44014

44042 (LA—7803-MS) **Flux effect on an aligned second foil due to multiple scattering of 800-MeV protons in the leading foil.** Coulter, C.A.; Sommer, W.F. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 8p. Dep. NTIS, PC A02/MF A01.

The high penetrating power of 800-MeV protons in metal samples invites considering aligning several samples along the beam direction in order to best utilize available experimental volume and to achieve uniform dose, sample to sample. Multiple scattering of the protons within each foil is the limit on the number and/or the geometry of the foils that will receive uniform dose. This calculation estimates the flux effect on an aligned second foil due to multiple scattering in a leading foil. The numerical results shown are for a given geometry of aluminum foils. Determination of a particular geometry and knowledge of the radiation length of a given material allows extension of this calculation.

44043 (LA-UR—79-1407) **LAMPF results on μ^+ diffusion in metals.** Leon, M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. Dep. NTIS, PC A02/MF A01.

Some recent results on the diffusion of positive muons in metals are discussed. The depolarization rate in very high purity vanadium, niobium, aluminum, silver, and rare earth alloys of the last two is found and described. (JFP)

44044 (SAND—79-0386) **CHARTB multigroup transport package.** Baker, L. (Sandia Labs., Albuquerque, NM (USA)). Mar 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

The physics and numerical implementation of the radiation transport routine used in the CHARTB MHD code are discussed. It is a one-dimensional (Cartesian, cylindrical, and spherical symmetry), multigroup,, diffusion approximation. Tests and applications will be discussed as well.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 44014, 44044

44045 Determination of low-field critical parameters of superconducting niobium by small-angle neutron diffraction. Christen, D.K.; Spooner, S.; Thorel, P.; Kerchner, H.R. (Oak Ridge National Lab., TN (USA)). *J. Appl. Crystallogr.;* **11**: No. 5, 650-653(1 Oct 1978).

From 4. international conference on small-angle scattering of X-rays and neutrons; Gatlinburg, TN, USA (3 - 7 Oct 1977).

The double-perfect-crystal small-angle diffraction technique enables measurement of scattering angles to within an accuracy of 0.3 sec of arc. At a wavelength of 2.55 A, this provides a resolution of 3 X $10^{-6}A^{-1}$ in the scattering vector. This technique has been used to study the anisotropic bebavior of the critical parameters B_0 and Hsub(c1) characteristic of the first-order magnetic phase transition which occurs in low kappa type II superconductors. Magnetic fields were applied parallel to several crystal axes in the (11¯0) and (100) planes of a large single-crystal sphere of pure niobium, resulting in well-defined flux-line lattices (FLL). Measurement of the FLL cell area in the intermediate mixed-state-field region gives the equilibrium flux density B_0 which results from an attractive interaction between fluxoids. In addition, field variation of the scattered neutron intensity allows measurement of the transition field between the mixed state and intermediate mixed state. This transition field is related to the lower critical field Hsub(c1) and enables its determination to a precision of 0.2%. Data at T=4.3 K display a small anisotropic effect of about 2% in B_0 and 1% in Hsub(c1). Although orientation effects of this magnitude are difficult to resolve by bulk measurements, the neutron data are in accord with magnetization data. The temperature dependence of these parameters is found to be in qualitative but not quantitative agreement with current theoretical models.

MEDICAL PHYSICS

DOSIMETRY

44046 (PB—287805) **Central-axis 60co ionization measurements in graphite as a function of phantom diameter, depth, and field size.** Domen, S.R. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Sep 1978. 21p. NTIS PC A02/MF A01.

Ionization measurements along the central axis were made in a graphite phantom irradiated with cobalt-60 gamma rays. The measurements were made under the following conditions: phantom diameters of 15, 20, and 30 cm; 15 depths from 1 to 39 g/sq cm; and square field sizes of 8.3, 10.5, 12.4, and 17.4 cm at a fixed detector position of 1 m from the source. Empirical fits to the data aid in correcting calorimeter comparisons to a common geometry.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 43435, 43938

44047 (SAND—79-0544C) **Frequency dependence of hopping conductivity.** Richards, P.M. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 9p. (CONF-790538—5). Dep. NTIS, PC A02/MF A01.

From Fast ion transport in solids-electrode and electrolytes conference; Lake Geneva, WI, USA (21 May 1979).

The ionic hopping conductivity is shown to have the frequency dependence $\sigma(\omega) = \sigma(\infty) - [\sigma(\infty)] - \sigma(0)]/(1 + \omega^2 tau^2)$ in two simple models: (i) a general two-inequivalent sublattice system with no interactions other than exclusion of double-site occupancy; (ii) a linear chain of equivalent sites with nearest neighbor interactions as well as double-site-occupancy exclusion. The characteristic time tau for frequency dependence can be much shorter than a hopping time tau/sub dc/ inferred from dc conductivity; and $\sigma(0)/\sigma(\infty)$ increases to unity at high temperatures. These features agree qualitatively with data on Na β-alumina.

44048 (UCRL—81797) **Design and analysis of isentropic compression experiments.** Hawke, R.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 May 1979. Contract W-7405-ENG-48. 23p. (CONF-790540—4). Dep. NTIS, PC A02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

The use of magnetic flux compression to isentropically compress matter is summarized. Details of the process used to extract boundary data from the flash radiographs and the design criteria for the containment of very compressible material are discussed. Finally, suggestions for improvement of the next generation of experiments are made.

44049 Splitting of the dispersion relation of surface plasmons on a rough surface. Kretschmann, E.; Ferrell, T.L.; Ashley, J.C. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev. Lett.;* **42**: No. 19, 1312-1314(7 May 1979).

The dispersion relation for surface plasmons on a statistically slightly rough surface is shown to display a splitting under certain conditions. For a simple model of the correlation function of the surface roughness, explicit calculations are made which explain experimantal results not previously interpreted.

44050 Dc voltage dependence of semiconductor grain-boundary resistance. Pike, G.E.; Seager, C.H. (Sandia Laboratories, Albuquer-

que, New Mexico 87185). *J. Appl. Phys.;* **50**: No. 5, 3414-3422(May 1979).

A model is developed to describe the potential barriers which often occur at grain boundaries in polycrystalline semiconductors. The resistance of such materials is determined by thermionic emission over these barriers. The dc grain-boundary current density as a function of applied voltage is calculated using several forms for the density of defect states within the boundary region. In all cases, the currents are Ohmic at low voltages; they can attain a quasisaturated level at intermediate voltages, and they display a sharp bias dependence at high voltages. The details of the intermediate and high-voltage characteristics are found to depend strongly on the grain-doping density and on the density and energy distribution of defect states at the grain boundary. Contrary to previous assertions, we find that the large current-voltage nonlinearities found in real materials are most likely associated with defect-state densities that decrease above the zero-bias Fermi level. The results of the model are compared with previous experimental data on Si and Ge bicrystals and on polycrystalline ZnO varistors. Finally, a detailed method for determining the energy density of grain-boundary defect states from current-voltage data is developed.

44051 Impurity scattering on the Fermi surfaces: A (more) realistic calculation. Cole, L.; Lawrence, W.E.; Monnier, R.; Joss, W.; van der Mark, W.; Manninen, M. (Department of Physics, Dartmouth College, Hanover, New Hampshire 03755). *Phys. Rev. Lett.;* **42**: No. 17, 1174-1178(23 Apr 1979).

The electron-impurity scattering rate and resulting Dingle temperatures X@sub D@ are calculated for dilute AlLi. The multiple—plane-wave model of Sorbello is used, but unlike previous approaches the scattering of individual plane waves is treated self-consistently, using the Kohn-Sham density-functional method (and including the main effect of the lattice potential). Electron-phonon renormalization of X@sub D@ is included. We discuss the implications of the local approximation for the exchange and correlation.

44052 Coherent locator approach to lattice vibrations in alloys with diagonal and geometrically-scaled off-diagonal disorder. Mostoller, M.; Kaplan, T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 3938-3943(15 Apr 1979).

A single-site coherent locator approach to lattice vibrations in alloys with both mass disorder and force-constant changes which obey geometric scaling has been proposed by Gruenewald. We show that this theory reduces to a virtual-crystal form for the special case of "equal" mass and force-constant changes, and that it fails to give satisfactory spectral limits for one- and three-dimensional model alloys.

44053 Molecular dynamics of shock waves in one-dimensional chains. II. Thermalization. Straub, G.K.; Holian, B.L.; Petschek, R.G. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Phys. Rev., B: Condens. Matter;* **19**: No. 8, 4049-4055(15 Apr 1979).

The thermalization behavior behind a shock front in one-dimensional chains has been studied in a series of molecular-dynamics computer experiments. We have found that a shock wave generated in a chain initially at finite temperature has essentially the same characteristics as in a chain initially at zero temperature. We also find that the final velocity distribution function for particles behind the shock front is not the Maxwell-Boltzmann distribution for an equilibrium system of classical particles. For times long after the shock has passed, we propose a nonequilibrium velocity distribution which is based upon behavior in the harmonic and hard-rod limits and agrees with our numerical results. Temperature profiles for both harmonic and anharmonic chains are found to exhibit a long-time tail that decays inversely with time. Finally, we have run a computer experiment to generate what qualitatively resembles solitons in Toda chains by means of shock waves.

44054 Analysis of grain boundary permeation in solids. Holloway, P.H.; McGuire, G.E. (Sandia Lab, Albuquerque, NM). *J. Electrochem. Soc.;* **125**: No. 12, 2070-2075(Dec 1978).

Methods are described to extract the grain boundary diffusion coefficient from experimental measurements of surface concentration of a diffusion species. For Type C kinetics, where bulk transport is negligible, easily used exact analytical solutions are available for infinite source and zero or infinite sink boundary conditions. For infinite or finite source and finite sink boundary conditions, the surface concentration is described by an exponential curve if the surface capacity is larger than the grain boundary capacity. The finite sink analysis has been applied to chromium diffusing in platinum, and D/sub b/ was found to equal $1.1*10^{-3}$ exp (-31,700/RT). For Type B kinetics, where bulk transport is not negligible, equations developed by M. Wuttig and Birnbaum may be used with a general criterion for approximating the bulk lattice flux developed in this work.

44055 (IS-Trans—106) **Theory of interstitial ordering in alloys with hexagonal close-packed crystal lattice.** Bugaev, V.N. Translated from *Ukr. Fiz. Zh. (Russ. Ed.);* **23**: No. 7, 1073-1080(1978). 14p. (VAAP—00-2). Dep. NTIS, PC A02/MF A01.

There are many interstitially-ordered alloys with hexagonal close-packed crystal lattice, HCP, for example, solid solutions of oxygen in alpha-titanium, zirconium, hafnium, carbon in tantalum and tungsten, nitrogen in iron and cobalt. Usually the interstitial atoms in HCP-lattice alloys occupy octahedral interstices. In previous work, ordering of oxygen atoms in titanium was theoretically investigated, but only the interaction between nearest interstitial atoms was considered, and under a priori assumptions that limited the number of possible superstructures of these atoms. The goal of the present work is to construct a theory on the ordering of interstitial atoms in alloys with HCP crystal lattice, accounting for interatomic interaction in an arbitrary number of coordination spheres. The discussion is conducted within the framework of the method of statistical concentration waves. For simplicity, the distribution of interstitial atoms about the interstices of pure metals (at the lattice sites) is studied, which confines the discussion to hexagonal lattices formed by octahedral interstices.

SUPERCONDUCTIVITY

GENERAL THEORY

44056 Quasiparticle branch mixing rates in superconducting aluminum. Chi, C.C.; Clarke, J. (Department of Physics, University of California and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **19**: No. 9, 4495-4509(1 May 1979).

The kinetic equation is used to compute the elastic and inelastic quasiparticle branch mixing rates for a superconducting film into which quasiparticles are injected via a tunnel barrier from a second superconducting film. Representative graphs are presented of the steady-state quasiparticle distribution, the quasiparticle charge imbalance Q* versus injection current, the charge relaxation rate tau^{-1}/sub Q/* vs Δ/k/sub B/T/sub c/ for several values of elastic scattering rate, and the quasiparticle branch relaxation rate tau^{-1}/sub Q/ as a function of energy. The quasiparticle potential developed in the injection film is related to tau^{-1}/sub Q/, and thence to tau$^{-1}_0$, a characteristic electron-phonon scattering time. Detailed measurements of tau/sub Q/ are reported for films of superconducting Al, some of which were doped with oxygen to give a range of transition temperatures from 1.2 to 2.1 K. From the dependence of tau^{-1}/sub Q/* on Δ/k/sub B/T/sub c/, values are deduced for the gap anisotropy of the films. In the cleanest samples, $\tau_0 < 0.10 +- 0.02$ μsec, a value that is in good agreement with energy-gap relaxation and 2Δ-phonon (phonons of energy $>$ or $\approx 2\Delta$) mean-free-path measurements, but a factor of about 4 smaller than that obtained from recombination time measurements and theoretical calculations. The value of tau^{-1}/sub o/ in the Al films increases with the transition temperature T/sub c/ as T^5/sub c/ or T^6/sub c/, instead of T^3/sub c/ as predicted by simple theory. It is suggested that the rapid increase of tau$^{-1}_0$ with T/sub c/ may arise from either a strong dependence of α^2F (ω) on T/sub c/ or from a small concentration of magnetic impurities.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 43422, 43473, 44045

44057 (IS-T—850) **Kinetic models for irreversible processes on a lattice.** Wolf, N.O. (Ames Lab., IA (USA)). Apr 1979. Contract W-7405-ENG-82. 225p. Dep. NTIS, PC A10/MF A01.

Thesis.

The development and application of kinetic lattice models are considered. For the most part, the discussions are restricted to lattices in one-dimension. In Chapter 1, a brief overview of kinetic lattice model formalisms and an extensive literature survey are presented. A review of the kinetic models for non-cooperative lattice events is presented in Chapter 2. The development of cooperative lattice models and solution of the resulting kinetic equations for an infinite and a semi-infinite lattice are thoroughly discussed in Chapters 3 and 4. The cooperative models are then applied to the problem of theoretically dtermining the sticking coefficient for molecular chemisorption in Chapter 5. In Chapter 6, other possible applications of these models and several model generalizations are considered. Finally, in Chapter 7, an experimental study directed toward elucidating the mechanistic factors influencing the chemisorption of methane on single crystal tungsten is reported. In this it differs from the rest of the thesis which deals with the statistical distributions resulting from a given mechanism.

44058 Theory of ac losses in type-II superconductors with a field-dependent surface barrier. Clem, J.R. (Ames Laboratory—USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *J. Appl. Phys.;* **50**: No. 5, 3518-3530(May 1979).

The irreversible magnetic behavior of a type-II superconductor in a periodically varying longitudinal applied magnetic field is theoretically examined. Bulk pinning is characterized by a critical current density J/sub c/, and surface-barrier effects are characterized by critical entry and exit fields H@sub en@ and H@sub ex@. Theoretical expressions for magnetic field and flux-density profiles, voltage waveforms, hysteretic-bulk and surface-energy losses, and the ac permeability are derived for the arbitrary flux-density (B) dependence of J/sub c/, H@sub en@, H@sub ex@, and the equilibrium magnetic field H@sub eq@. Numerical model calculations are performed to demonstrate the influence of the B dependence of the latter functions upon the measurable quantities.

44059 (BNL-tr—666) **Anomalous diamagnetism (high-temperature Meissner effect?) in a CuCl compound.** Brandt, N.B.; Kuvshinnikov, S.V.; Rusakov, A.P.; Semenov, M.V. Translated from *Pis'ma Zh. Eksp. Teor. Fiz.;* **27**: No. 1, 37-43(1978). 11p. (VAAP—00-1). Dep. NTIS (US Sales Only), PC A02/MF A01.

The model of the electron spectrum with a large direct forbidden band E/sub D/ and a small indirect forbidden band E/sub g/ or with a small indirect overlapping of the valence band and the conduction band is of particular importance in the theoretical studies of high-temperature superconductivity and phase transition to the excitonic dielectric state. By taking into account other conditions, the instability of the excitonic or superconducting pairing with high critical temperatures T/sub c/ can be predicted for these systems. In view of this, the CuCl compound, whose energy spectrum corresponds to the model indicated above, is of particular interest. The results of optical measurements, dilatometric and x-ray studies, and measurements of the magnetic, thermal, and electric properties at high pressures confirm the presence of a small indirect gap in CuCl and a lower binding energy of the excitons E/sup d/. If E/sup d/ $\geqq$ E/sub g/ $<<$ E/sub D/, then the CuCl crystal at room temperature is in the excitonic dielectric state with the effective hole-to-electron mass ratio m/sub h//m/sub e/ $>>$ 1. Since the parameters of the spectrum must be chosen very carefully for superconductivity to occur and since it can occur only in a narrow range of values of these parameters, the temperature dependences of the magnetic susceptibility and the electrical conductivity of CuCl specimens manufactured by different methods at hydrostatic pressures of up to 10 kbar were investigated under equilibrium and nonequilibrium conditions in the temperature range of 4.2 to 350 K.

THEORETICAL PHYSICS

RELATIVITY AND GRAVITATION

44060 (N—79-11934) **Critical comments on the constancy of the speed of light.** Hsu, J.P.; Sherry, T.N. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1977. Contract EY-76-S-05-3992. 13p. NTIS PC A02/MF A01.

Criticisms on the theory of the constancy of the speed of light are answered. It is shown that the new theory is not logically inconsistent for the reasons expressed.

ACOUSTICS

44061 Interpretation of elastic-wave scattering theory for analysis and design of flaw-characterization experiments: The long-wavelength limit. Gubernatis, J.E.; Krumhansl, J.A.; Thomson, R.M. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Appl. Phys.;* **50**: No. 5, 3338-3345(May 1979).

Recently, the results of a general theory of the scattering of elastic waves from a flaw embedded in an isotropic medium were shown in the far-field limit to be compactly represented by a single vector, the f vector. Studying the f vector is thus a way to investigate systematically the dependence of the scattering on the polarization of the incident mode, scattering angle, changes in material parameters, and shape. In the long-wavelength limit the f vector is exactly determinable and exhibits significant features of the flaw. We discuss long-wavelength scattering results for volume flaws and idealized cracks and compare some of the results with those of the Born approximation, which has already been calibrated by comparison to exact calculations and experiment.

STATISTICAL PHYSICS AND THERMODYNAMICS

44062 Calculation of the Kolmogorov entropy for motion along a stochastic magnetic field. Rechester, A.B.; Rosenbluth, M.N.; White, R.B. (Bell Laboratories, Murray Hill, New Jersey 07974). *Phys. Rev. Lett.;* **42**: No. 19, 1247-1250(7 May 1979).

An expression for the Kolmogorov entropy has been derived. Excellent agreement between a probability description and direct dynamical computations has been found.

44063 Spectrum and eigenfunctions for a Hamiltonian with stochastic trajectories. McDonald, S.W.; Kaufman, A.N. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev. Lett.;* **42**: No. 18, 1189-1191(30 Apr 1979).

Quantum stochasticity (the nature of wave functions and eigenvalues when the short-wave-limit Hamiltonian has stochastic trajectories) is studied for the two-dimensional Helmsholtz equation with "stadium" boundary. The eigenvalue separations have a Wigner distribution (characteristic of a random Hamiltonian), in contrast to the clustering found for a separable equation. The eigenfunctions exhibit a random pattern for the nodal curves, with isotropic distribution of local wave vectors.

ELECTRICITY AND MAGNETISM

44064 (AD-A—059914) **Effect of multiple scattering on the Compton recoil current. Topical report dec 77-feb 78.** Longmire, C.L. (Mission Research Corp., Santa Barbara, CA (USA)). Feb 1978. Contract DNA001-77-C-0135. 52p. NTIS PC A04/MF A01.

This report explains the approximate method used in the CHAP EMP computer code for calculating the Compton current as affected by multiple scattering, and compares its results with those from more accurate Monte Carlo calculations. It is shown that the CHAP method provides good accuracy. Results computed by Sollfrey are also compared with the Monte Carlo results, and found to be less accurate than expected.

44065 (UCRL—82105) **Numerical Electromagnetics Code: a program for antenna system analysis.** Burke, G.J.; Poggio, A.J.; Logan, J.C.; Rockaway, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Naval Ocean Systems Center, San Diego, CA (USA)). Dec 1978. Contract W-7405-ENG-48. 7p. (CONF-790522—1). Dep. NTIS, PC A02/MF A01.

From EMC symposium and exhibition; Rotterdam, Netherlands (1 May 1979).

A computer program entitled Numerical Electromagnetics Code (NEC) will be described and its various capabilities listed. An example of its applications to EMC analysis is presented. Also, its extensive documentation is described.

44066 (UCRL—82323) **Natural mode methods in frequency and time domain analysis.** Miller, E.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1979. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

Electromagnetic (EM) fields are described by second-order differential equations the source-free solutions of which are exponential in the time domain. Their corresponding frequency-domain solutions are given by a series of poles in the complex frequency plane. This basic fact has led to the Singularity Expansion Method (SEM) as a way to characterize both the transient and spectral EM fields of an object in terms of a set of common poles and residues. In principal, the SEM provides a means to do this for arbitrary excitation. But a condition necessary to implement the SEM is that a method must be available for finding the poles of the object, the realization of which is the primary topic of this report. A number of techniques have been tested for obtaining the EM poles of antennas and scatterers. Prony's Method is useful, not only for computed or measured transient response data, but also, with slight modification, for spectral data. Its analytical development is outlined. Some introductory numerical results are given, and its application is demonstrated for various types of data and objects. Use of poles for target identification from both transient and spectral data is considered. The discussion concludes with a demonstration of other ways in which poles can arise and be useful in electromagnetics, such as pattern synthesis and the one-dimensional inverse problem. 30 figures, 5 tables. (RWR)

44067 Observation of particle trajectories near a magnetized fiber. Treat, R.P.; Lawson, W.F.; Johnson, J.L. (Morgantown Energy Technology Center, USDOE, Morgantown, West Virginia 26505). *J. Appl. Phys.;* **50**: No. 5, 3596-3602(May 1979).

The motions of 20—30-μm paramagnetic particles have been observed in the neighborhood of a 250-μm ferromagnetic fiber. The particles are entrained in nitrogen flowing down over a horizontal fiber. The particles and fiber are magnetized by a vertical magnetic field of strength up to 0.73 T. The free-stream velocities range from nearly zero to 1 m/sec. A Fastax movie camera is used to record the positions of the particles as they pass by or collide with the fiber. The particle trajectories thus observed determine the collision cross section as a function of field strength and free-stream velocity. Cross sections of over five diameters are observed. The cross sections and

trajectories are compared and agree with the Newtonian theory of the particle motion. The theory assumes potential flow over the fiber and accounts for the magnetic, viscous, and gravitational forces and particle inertia, all of these being significant in the range of conditions considered. The observed trajectories show details of the motion which are clear manifestations of particle inertia. The sharp particle shadows cast by the isolated fiber are a striking feature of the trajectory patterns. Such shadows should be the source of an intereference effect in multiple-fiber filters.

FUSION ENERGY

REFER ALSO TO CITATION(S) 43245

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

44068 (ORNL/TM—6703) **Electron-cyclotron heating of toroidal plasma with emphasis on results from the ELMO Bumpy Torus (EBT).** Dandl, R.A.; Eason, H.O.; Ikegami, H. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A04/MF A01.

Microwave heating at the electron-cyclotron frequency has been effectively employed to heat plasmas confined in open and closed magnetic confinement geometry where the applied heating frequency was near or above the plasma frequency. The earliest experimental investigations demonstrated the effectiveness of plasma electron-cyclotron heating (ECH) and later theoretical work validated these observations. In this review, we briefly consider some of the more relevant ECH propagation processes and heating mechanisms. Results are presented from some of the more recent toroidal ECH experiments, including tokamaks, but principally from the ELMO Bumpy Torus (EBT). In the last section, we discuss the technological considerations so important to successful applications of ECH to plasma experiments.

44069 (PPPL—1545) **ICRF heating and wave generation in the ATC tokamak. Part 1: wave generation, propagation and absorption.** Takahashi, H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1979. Contract EY-76-C-02-3073. 92p. Dep. NTIS, PC A05/MF A01.

Experimental results and their theoretical interpretations of rf heating experiments in the ion cyclotron range of frequencies are presented. The presentation is in two parts, with this part describing the experimental facilities and characteristics of fast compressional Alfven waves in the tokamak, and a subsequent paper which will deal with the pricipal heating results. It is shown that a simple coupling structure which consists essentially of a semi-circular metal strip and a pair of bumper limiters is sufficient to efficiently couple rf power to the plasma. The major part of the coupled power is radiated as the fast wave, and there is no evidence that parasitic loading, if any, accounts for a significant amount of the power. A coupling efficiency (net coupled power/incident power) in excess of 90% is routinely obtained.

44070 **Stability of field-reversed, force-free, plasma equilibria with mass flow.** Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.;* **42**: No. 19, 1277-1281(7 May 1979).

The existence of a special set of cusp-shaped, stable, force-free plasma equilibria with finite pressure and flow velocity is demonstrated. They are confined by surface currents.

44071 **Charge exchange cooling in the tandem mirror plasma confinement apparatus.** Logan, B.G. (to Dept. of Energy). US Patent 4,127,442. 28 Nov 1978. Filed date 16 Jun 1977. 10p.

PAT-APPL-807,082.

A method and apparatus are described for cooling a plasma confined in the center mirror cell of the tandem mirror apparatus by injecting cold neutral species of the plasma into at least one mirroring region of the center mirror cell. The cooling is due to the loss of warm charged species through charge exchange with the cold neutral species with resulting diffusion of the warm neutral species out of the plasma.

PLASMA DIAGNOSTICS

44072 (UCRL—81725) **Intensified CCD for ultrafast diagnostics.** Cheng, J.; Tripp, G.; Coleman, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Sep 1978. Contract W-7405-ENG-48. 13p. (CONF-7810172—1). Dep. NTIS, PC A02/MF A01.

From 1978 international conference on the application of charge coupled devices; San Diego, CA, USA (25 Oct 1978).

Portions of document are illegible.

Many of the present laser fusion diagnostics are recorded on either ultrafast streak cameras or on oscilloscopes. For those experiments in which a large volume of data is accumulated, direct computer processing of the information becomes important. We describe an approach which uses a RCA 52501 back-thinned CCD sensor to obtain direct electron readouts for both the streak camera and the CRT. Performance of the 100 GHz streak camera and the 4 GHz CRT are presented. Design parameters and computer interfacing for both systems are described in detail.

44073 **Measurement of H^- density in plasma by photodetachment.** Bacal, M.; Hamilton, G.W.; Bruneteau, A.M.; Doucet, H.J.; Taillet, J. (Laboratoire de Physique des Millieux Ionises, Ecole Polytechnique: 91128 Palaiseau Cedex, France). *Rev. Sci. Instrum.;* **50**: No. 6, 719-721(Jun 1979).

Techniques have been developed for measurement of the density of H^- in a plasma by photodetachment. Photodetachment is detected by the increase in electron density with no change in positive ion density after a light pulse from a ruby laser. The authenticity of photodetachment signals can be assured by their comparison with known cross sections for photodetachment of H^-. Interpretations of photodetachment data are less ambiguous than probe interpretations because photodetachment is not affected by the mass of positive ions and is not limited in usefulness by the Debye distance. Photodetachment measurements with time resolution and spatial resolution are straightforward.

44074 **Scanning multiple collector electrostatic analyzer with application to plasma potential measurement.** Boedeker, L.R. (United Technologies Research Center, East Hartford, Connecticut 06108). *Rev. Sci. Instrum.;* **50**: No. 6, 722-726(Jun 1979).

Three collector electrodes have been located accurately on the focal plane of a parallel-plate electrostatic energy analyzer to form an exit slit matched to a large inlet slit by the design magnification ratio. In bench tests with a nearly uniform, monoenergetic K^+ beam at 5 kV these collectors have been found to provide a scanning capability for measurement of the energy of such a large beam with sufficient precision, $\Delta V/V \sim +\text{-}\ 10^{-3}$, to resolve plasma potential in heavy ion probe diagnostic studies of magnetically confined plasmas. In such studies a wide entrance slit is needed because of low signal levels. The method provides enhanced resolution with greater facility than obtainable with a feedback approach used in prior investigations. A nearly triangular sharply peaked profile was observed on the center collector providing the desired resolution. Scans at various entrance angle settings have been made and beam size and peak location results compared with predictions based on the existing model for an ideal instrument.

44075 **Determination of the gas temperature of a low-pressure plasma from the intensities of the H_2 and D_2 molecular bands. 1: Rotational structure of the Fulcher band system.** Lavrov, B.P.; Otorbaev, D.K. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **45**: No. 6, 859-862(Dec 1978).

The literature data and measurements with high resolution emission spectra of a low-pressure arc discharge are analyzed in order to develop a method which is used, along with the necessary numerical data, to determine the rotational temperature of a plasma from the relative intensities of the spectral lines of the rotational structure of the diagonal vibronic bands of the Fulcher system for molecular hydrogen (the transitions $1s\sigma 3p\pi\ ^3Pi/sub\ u/,v' \rightarrow 1s\sigma 2s\sigma\ ^3\Sigma^+/sub\ g/,v''$ for $v' < v'' < 0, 1, 2$).

PLASMA KINETICS - GENERAL

REFER ALSO TO CITATION(S) 44187

PLASMA KINETICS - EXPERIMENTAL

44076 (CONF-790645—2) **Gas injection in EBT-S for assessment of particle loading effects of neutral beam injection.** Carpenter, K.H.; Glowienka, J.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

From IEEE international conference on plasma science; Montreal, Canada (4 Jun 1979).

Experiments have begun to examine the physics of neutral beam injection on EBT-S. Preliminary experiments have been limited to a calibrated gas puffing experiment which simulates the effects of a pulsed beam with zero energy. These experiments begin to address some of the compatibility problems that exist for future beam heating experiments on EBT devices. In particular, neutral beams are to be a significant part of the planned EBT-II experiment which is designed to demonstrate steady-state, reactor-like conditions with both electron cyclotron heating and neutral beam heating.

44077 (COO—2218-125) **Comments on proposed experimental study of fusion product losses from PLT and TFTR plasmas.** Hively, L.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). Oct 1978. Contract EY-76-S-02-2218. 8p. Dep. NTIS, PC A02/MF A01.

An experimental technique is proposed for measuring the fusion product leakage from the PLT and TFTR tokamaks. The experiment would use two detectors (one at the top and one at the outboard side of the torus) shielded, and facing away from the plasma so that fusion products can enter along gyro-helices. (MOW)

44078 (GA-A—15338) **Analysis of the Impurity Flow Reversal Experiment.** Burrell, K.H.; Wong, S.K.; Amano, T. (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract EY-76-C-03-0167-038. 47p. Dep. NTIS, PC A03/MF A01.

Experiments performed on the Impurity Study Experiment (ISX-A) tokamak have shown that poloidally asymmetric injection of hydrogen gas can alter the inward transport of injected impurity atoms. We have compared the observed transport times and the magnitude of the flow reversal effect with a model based on the neoclassical theory of impurity transport and find that the observations are consistent with the theory. However, uncertainities in the radial profiles and the atomic rate coefficients do not permit a truly definitive test of the theory.

44079 (LA-UR—79-1409) **Results from the Los Alamos Fast Liner Experiment.** Sherwood, A.R.; Cantrell, E.L.; Ekdahl, C.A.; Henins, I.; Hoida, H.W.; Jarboe, T.R.; Klingner, P.L.; Malone, R.C.; Marshall, J.; Sawyer, G.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-790540—8). Dep. NTIS, PC A02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

Experimental results for aluminum liners imploded magnetically were obtained using a 1.75 MJ portion of the Scyllac capacitor bank at Los Alamos. Typical liner dimensions are 10-cm length, 5-cm diameter, and 1-mm initial thickness; because they are thick, these liners remain near solid density throughout the implosion. Implosion velocities of 4 to 6 x 10^5 cm/s have been consistently attained. These results agree well with theoretical calculations, which will also be presented. Results obtained with various diagnostics will be presented including voltage and current measurements, pin probes, magnetic field compression probes, and flash x-ray shadowgraphs.

44080 (PPPL—1542) **Toroidal plasma rotation in PLT induced by neutral beam injection.** Suckewer, S.; Eubank, H.P.; Goldston, R.J.; Hinnov, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 18p. Dep. NTIS, PC A02/MF A01.

Toroidal plasma rotation, generated by toroidally unbalanced neutral beam injection into the Princeton Large Torus, has been measured by Doppler shifts of several atomic spectral lines. These measurements produce the time evolution and spatial distribution of the rotation from which a momentum confinement time, comparable to the ion energy confinement time, is deduced.

44081 (UCRL—81962) **Ion beam production in the plasma focus device.** Gullickson, R.L.; Pickles, W.L.; Price, D.F.; Sahlin, H.L.; Wainwright, T.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1979. Contract W-7405-ENG-48. 20p. (CONF-781247—3). Dep. NTIS, PC A02/MF A01.

From 2. international conference on energy storage, compression and switching; Venice, Italy (5 Dec 1978).

Livermore results are reviewed and compared with recent measurements of high energy ions in the plasma focus device at other laboratories. We will also discuss diagnostic techniques for measuring high energy ions including nuclear activation, particle track detectors, solid state (silicon PIN) detectors, and neutron time-of-flight measurements.

44082 **Small-scale magnetic fluctuations inside the Macrotor tokamak.** Zweben, S.J.; Menyuk, C.R.; Taylor, R.J. (Center for Plasma Physics and Fusion Engineering, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **42**: No. 19, 1270-1274(7 May 1979).

Magnetic pickup loops inserted into the Macrotor tokamak have shown a broad spectrum of oscillation in B/sub r/ and B/sub p/ up to f ≅ 100 kHz. The high-frequency B/sub r/ have short radial and poloidal correlation lengths L < 5 cm, in contrast with the usual Mirnov oscillations with f ≅ 7 kHz and L >> 5 cm. The observed magnitude summationvertical-barB/sub r/vertical-bar/B/sub T/ > 10^{-5}, where the summation extends over all f > 30 kHz, is in the range in which such radial magnetic perturbations may be contributing to anomalous electron energy transport.

44083 **Transfer of appreciable angular momenta in electron excitation of molecules.** Otobraev, D.K.; Ochkin, V.N.; Savinov, S.Y.; Sobolev, N.N.; Tskhai, S.N. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 392-396(20 Sep 1978).

It was experimentally established with the H_2 and D_2 molecules as an example that when electron-vibrational-rotational states are excited by direct impact the angular momenta of the molecules can change by as much as (5—6) h.

PLASMA KINETICS - THEORETICAL

44084 (GA-A—15323) **Trace impurity transport code.** Wong, S.K. (General Atomic Co., San Diego, CA (USA)). Feb 1979. Contract EY-76-C-03-0167-038. 36p. Dep. NTIS, PC A03/MF A01.

FLOREX is a code which solves the coupled transport equations of all the charge states of a single impurity atomic species in a fixed plasma background. The impurity ions are taken to be present in a trace amount so that their self-collisions are neglected. Consequently, the coupling is due entirely to ionization and recombination. This report describes the equations, the numerical method, and an example of its use in the impurity flow reversal experiment.

44085 (ORNL/TM—6597) **User's guide to program MAD: a computer program for the organization and manipulation of magnetic tape directories.** Gray, W.H. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 39p. Dep. NTIS, PC A03/MF A01.

MAD is a computer program for the organization and manipulation of the information contained in magnetic tape directories. Program MAD creates, updates, and interrogates a set of four random access files collectively called the MAD unified data base. Although program MAD was originally intended as an information compression mechanism, it has evolved into an organization system with the added feature of an approximately 60% reduction in the space required to store the data. This program is easy to use, relatively fast, efficient in its use of disk space, and available to all users of the Fusion Energy Division DECsystem-10.

44086 (ORNL/TM—6852) **Computer modelling of the bundle divertor. Part I. Basic equations.** Nicolai, A.; Mense, A.T. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG026. 49p. Dep. NTIS, PC A03/MF A01.

A set of six equations governing plasma parameters (hydrogen ion density, impurity ion density, electron temperature, and ion temperature) within the burial chamber of a bundle divertor and the potential steps in the divertor throat and in front of the divertor plate is presented. Secondary electron emission at the divertor plate, the particle and energy flow reduction due to the mirror, and the backflow of impurities into the scrape-off plasma are taken into account. The modelling is based mainly on the assumption that strong relaxation processes due to the microinstabilities arising because of the mirror and the secondary emission decrease the deviations from a Maxwellian distribution function to a negligible level in both the scrape-off region and the divertor chamber. Particle sink and energy loss terms due to the divertor are derived suited for 1-D transport code calculations. In this way, the plasma parameters in the scrape-off region can be calculated consistently to those of the central core and of the divertor chamber.

44087 (PPPL—1533) **Transport of electron thermal energy in high temperature plasmas.** Coppi, B.; Mazzucato, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 15p. Dep. NTIS, PC A02/MF A01.

The nature of the anomalous transport of electron thermal energy in existing experiments on magnetically confined toroidal plasmas is discussed and a new form of the relevant electron thermal conductivity, that is consistent with the observed temperature profiles, is presented.

44088 (PPPL—1552) **Neoclassical transport in helically symmetric plasmas.** Pytte, A.; Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 32p. Dep. NTIS, PC A03/MF A01.

The neoclassical rate of diffusion is calculated in such a way that the result is applicable to both helically symmetric and toroidally symmetric plasmas.

44089 (UCID—18186) **Controller routines for the DECsystem-10 with application to a tandem-mirror plasma code.** Faul, D.R.; Devoto, R.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Apr 1979. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

FORTRAN-callable subroutines have been written to enable controller—controllee interaction on the LLL DECsystem-10. These subroutines have been used to construct a controller (XTCTMR) for a tandem-mirror physics code (CTCTMR). A description of the subroutines and their use is presented. Also, sample results are given.

44090 Dynamics of tokamak discharges dominated by the trapped-electron instability. Klein, H.H.; Cotsaftis, M.; Krall, N.A.; McBride, J.B. (Science Applications, Inc., La Jolla, California 92037). *Phys. Rev. Lett.;* **42**: No. 17, 1144-1147(23 Apr 1979).

A space-time analysis of a typical high-current TFR discharge has been performed in terms of the trapped-electron instability whose effects are likely to occur in this parameter range. The evolution of both the electron and ion temperatures is consistent with the transport induced by this instability, but not with other transport models described. The structure of the discharge is calculated and some properties are illustrated.

44091 Binary correlation and convergent collision integral for a plasma. Mondt, J.P. (Physics Department, Eindhoven University of Technology, Eindhoven, Netherlands). *Ann. Phys. (N.Y.);* **117**: No. 1, 195-233(Jan 1979).

The BBGKY hierarchy equations for a homogeneous plasma are used to derive an explicit expression for the time—asymptotic binary correlation function. Closure of the hierarchy equations is shown possible, mainly due to a difference in scaling behavior, as functions of impact parameters(s), between the deriving terms in the second and third hierarchy equations. The final result is shown to be uniform approximation for interparticle distances much smaller than the minimum of the mean free path and the sensity inhomogeneity length. The resulting expressions for the free energy and the collision integral are convergent.

PLASMA PRODUCTION

44092 Absorption of laser radiation by Al, Fe, and Au planar metallic targets. Anthes, J.P.; Palmer, M.A.; Gusinow, M.A.; Matzen, M.K. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Appl. Phys. Lett.;* **34**: No. 12, 841-843(15 Jun 1979).

Experiments to determine the absorptance of an 8-nsec (FWHM) 1.064-μm laser pulse incident on metallic targets were performed using a well-characterized integrating sphere photometer. The absorptance was inferred by individually measuring the incident, back reflectd, and scattered laser radiation over the range $\approx 10^{13}$—10^{14} W/cm² for three different elemental planr targets (Al, Fe, and Au). The absorptance varied approximately linearly from 0.9 at 10^{13} W/cm² at 10^{14} W/cm² and was independent of target material. The experimental accuracy was +- 4%.

PLASMA INSTABILITIES

44093 (LA—7809-MS) Effect of the gas blanket on the stability of the dense z-pinch. Suydam, B.R. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

The stabilizing effect of the dense neutral gas blanket which surrounds the dense z-pinch as it is presently operated is studied. Because this gas can contribute to pressure balance, plasma pressure can fall to zero at some radius without introducing destabilizing surface currents which would be required for pressure balance without the gas. Thus pressure profiles are possible which are stable against interchange, and long wavelength kink modes are more easily stabilized by a wall. Internal kink modes are unaffected and are unstable.

44094 (LA—7814-MS) Nonlinear two-stream interaction between a cold, relativistic electron beam and a collisional plasma-Astron experiment. Newberger, B.S.; Thode, L.E. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

Experiments on the two-stream instability of a relativistic electron beam propagating through a neutral gas, carried out with the Lawrence Livermore Laboratory Astron beam, have been analyzed using a nonlinear saturation model for a cold beam. The behavior of the observed microwave emission due to the instability is in good agreement with that of the beam energy loss. Collisions on the plasma electrons weaken the nonlinear state of the instability but do not stabilize the mode. The beam essentially acts as if it were cold, a result substantiated by linear theory for waves propagating along the beam. In order to predict the effect of both beam momentum scatter and plasma electron collisions on the stability of the mode in future experiments a full two-dimensional linear theory must be developed.

44095 (ORNL/TM—6824) Effects of hot electrons on magnetohydrodynamic modes in EBT. Nelson, D.B. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

The effect of hot electrons on magnetohydrodynamic modes in EBT is studied using a fully electromagnetic, finite β, Vlasov—Maxwell model consisting of three species in an inhomogeneous slab geometry with gravity. If no hot electrons are present, the Vlasov model agrees with the magnetohydrodynamic model. If the density of hot electrons is small, but their temperature is sufficiently large, the Vlasov model predicts stabilization of magnetohydrodynamic modes. For EBT parameters this occurs at β = 10-20%, in agreement with experimental observations. The Vlasov model also validates, for EBT parameters, the assumption of rigid hot electrons made in a previous magnetohydrodynamic analysis incorporating the full EBT geometry.

44096 (ORNL/TM—6909) Stability study of high β flux conserving equilibria. Charlton, L.A.; Dory, R.A.; Peng, Y.K.M.; Strickler, D.J.; Lynch, S.J.; Lee, D.K.; Gruber, R.; Troyon, F. (Oak Ridge National Lab., TN (USA)). Jun 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

The Flux Conserving Tokamak (FCT) model suggested that rapid heating would yield equilibria with high relative energy density ($\beta = 2p/B^2$) while nonetheless allowing control over q, the so-called safety factor for instability within the ideal magnetohydrodynamic (MHD) plasma model. In this study, we show that this is adequate to provide stability to β values of 10%, if there is a conducting metal shell in the vicinity of the plasma.

44097 (PPPL—1541) Impurity effects on ion-drift-wave eigenmodes in a sheared magnetic field. Tang, W.M.; White, R.B.; Guzdar, P.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 32p. Dep. NTIS, PC A03/MF A01.

The stability of ion-drift-wave eigenmodes in a slab geometry with a sheared magnetic field is investigated. It is found that in contrast to the case of universal and dissipative electron drift wave eigenmodes, unstable impurity-driven normal modes can appear if specific conditions are satisfied. In addition, the influence of impurities on unstable ion-temperature-gradient-driven drift eigenmodes is also studied. It is found that, if their density profile is inwardly peaked, the impurities can exert a strong stabilizing influence on these modes.

44098 (PPPL—1543) Renormalized Compton scattering and nonlinear damping of collisionless drift waves. Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 47p. Dep. NTIS, PC A03/MF A01.

A kinetic theory for the nonlinear damping of collisionless drift waves in a shear-free magnetic field is presented. The general formalism is a renormalized version of induced scattering on the ions and reduces correctly to weak turbulence theory. The approximation studied explicitly reduces to Compton scattering, systematizes thee earlier calculations of Dupree and Tetreault (DT) [Phys. Fluids 21, 425 (1978)], and extends that theory to finite ion gyroradius. Certain conclusions differ significantly from those of DT.

44099 (PPPL—1544) Stability of drift-wave eigenmodes with arbitrary radial wavelengths. Lee, Y.C.; Chen, L.; Nevins, W.M. (California Univ., Los Angeles (USA). Dept. of Physics; Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 14p. Dep. NTIS, PC A02/MF A01.

A general theory for the stability of collisionless drift-wave eigenmodes in sheared slab magnetic fields is developed using the S-matrix technique. The eigenmodes are described with the integral formulation which fully takes into account the nonlocal effects of finite ion gyro-orbits. The universal eigenmode is then shown to be absolutely stable for arbitrary radial wavelengths.

44100 (PPPL—1547) Nonlinear drift tearing modes. Monticello, D.A.; White, R.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1979. Contract EY-76-C-02-3073. 28p. Dep. NTIS, PC A03/MF A01.

It is shown analytically and with a numerical code that the nonlinear growth and saturation of magnetic islands in tokamaks is not affected by diamagnetic corrections. Diamagnetic effects change the linear growth and introduce mode rotation, which persists in the nonlinear regime. The analysis is used to construct a model for the effect of feedback stabilization schemes in the nonlinear regime.

44101 (UCID—18181) Computationally convenient criterion for low-β interchange stability of tandem mirrors. Kaiser, T.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 May 1979. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

A sufficient condition for the low-β, short-wavelength, interchange stability of large-aspect-ratio systems possessing omnigenic symmetry is presented. It is accurately and rapidly computable entirely in terms of quantities generated by typical vacuum magnetic field calculation codes.

44102 Reconnecting modes in collisionless plasmas. Coppi, B.; Mark, J.W.; Sugiyama, L.; Bertin, G. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **42**: No. 16, 1058-1061(16 Apr 1979).

Processes involving magnetic-field reconnection in collisionless plasmas and relying on the effects of electron Landau resonance for their excitation are found to require the consideration of the self-consistent electric potentials and the systematic analysis of four

consecutive asymptotic regions. The new effects found are relevant to both laboratory and space plasmas.

44103 Destabilizing effect of shear and maximum pressure of plasma in a tokamak. Pogutse, O.P.; Yurchenko, E.I. (I. V. Kurchatov Institute of Atomic Energy). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 318-320(20 Sep 1978).

An analytic criterion is obtained for the stability of a plasma to ballooning modes. It takes into account two new physical effects, namely destabilization due to crossing of the flute-oscillation branches, and the balloon effect due to the shear.

44104 Stabilization of plasma drift instability in a stellarator by an alternating electric field near the frequency of the lower hybrid resonance. Voitsenya, V.S.; Voloshko, A.Y.; Solodovchenko, S.I.; Shpan', A.F. (Physicotechnical Institute, Ukrainian Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **28**: No. 6, 337-340(20 Sep 1978).

We have observed, in the "Saturn" stellerator, stabilization of the drift instability of a microwave discharge plasma in hydrogen externally excited by an alternating electric field near the lower hybrid resonance.

PLASMA WAVE PHENOMENA

44105 (UCLA-ENG—7931) **Microwave experimental simulation of laser plasma interactions. Combined quarterly status report, October 1, 1978—April 30, 1979.** Luhmann, N.C. Jr. (California Univ., Los Angeles (USA). Dept. of Electrical Sciences and Engineering). May 1979. Contract EY-76-C-03-0010-021. 27p. Dep. NTIS, PC A03/MF A01.

This program continues to stress the use of high power microwave sources (λ_0 = 1-30 cm) and large diameter quiescent laboratory plasmas in the investigation of the absorption and transport of energy in laser-pellet interactions. The large spatial scalelengths (1-4 m) and relatively long time-scales (10 nsec-10μsec) permit the careful measurement of localized electric and magnetic fields as well as particle energy and density. During the past seven months we have focussed our attention on experiments designed to address two problems of particular relevance to the laser fusion program. The first experiment has been concerned with an investigation of stimulated Brillouin scattering (SBS) in the underdense regions of the blow-off plasma. A separate experimental investigation aimed at an understanding of the generation of quasi-static magnetic fields was carried out. In this effort we are concerned with the production of magnetic fields in the vicinity of the critical layer due to resonance absorption, nonparallel temperature and density gradients and parameteric instabilities.

44106 Cold, electrostatic, ion-cyclotron waves and ion-ion hybrid resonances. Ono, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Phys. Rev. Lett.;* **42**: No. 19, 1267-1270(7 May 1979).

Experimental observation and studies of a new type of cold electrostatic mode near the ion-ion hybrid frequency are presented. The resonance cone behavior associtated with this mode is verified. The wave dispersion relation has been measured which shows a clear resonance behavior near the hybrid frequency. Associated with the mode, strong electron Landau damping by bulk electrons and equally strong ion damping near the ion-ion gybrid resonance are observed. This type of mode should be readily excited in high-field devices ($B_0 >$ or $\approx$ 30 kG).

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 43204

44107 (CONF-790463—1) **General machine and injection characteristics of the ISX-B injection experiment.** Edmonds, P.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From IAEA technical committee and workshop on the plasma physics of intense neutral beam heating in Tokamaks; Oak Ridge, TN, USA (25 Apr 1979).

Portions of document are illegible.

A brief preview of the session is given. A brief account of the ISX-B and ISX-B beamlines is given. A description of the procedures for power measurements is followed by a discussion of future plans.

44108 (DOE/TIC—4068-T1(App.1)) **Preliminary conceptual design study of the RIGGATRON approach to fusion power. Appendices A—O.** (INESCO, Inc., Arlington, VA (USA)). 27 Apr 1978. Contract EG-77-C-01-4068. 365p. Dep. NTIS, PC A16/MF A01.

The following appendices are included: (1) toroidal field coil membrane analysis; (2) toroidal field coil combined stresses; (3) toroidal field coil thermal analysis; (4) Ohmic heating coil design studies; (5) first wall thermal and structural considerations; (6) neutron sensor; (7) compressional heating model and poloidal field considerations; (8) auxiliary heating; (9) plasma physics Ohmic heating scaling and computations; (10) maximum beta limits; (11) rf preionization; (12) fusion power burn profile effects; (13) neutronics calculations; (14) O-D model for fusion burn control, and (15) startup and burn phase heating and power balance. (MOW)

44109 (DOE/TIC—4068-T1(App.2)) **Preliminary conceptual design study of the RIGGATRON approach to fusion power. Appendices P—T.** (INESCO, Inc., Arlington, VA (USA)). 27 Apr 1978. Contract EG-77-C-01-4068. 379p. Dep. NTIS, PC A17/MF A01.

The following appendices are included: (1) background information on high strength materials; (2) parametric systems analysis and economic studies; (3) RIGGATRON plants for materials irradiation testing; (4) RIGGATRON recycling model and cost; and (5) impact analysis of the commerical application of RIGGATRON fusion power concept. (MOW)

44110 (DOE/TIC—4068-T1(Vol.1)) **Conceptual design of physics proof-of-principle experiments for the RIGGATRON approach to fusion power. Final report.** (INESCO, Inc., Arlington, VA (USA)). 27 Apr 1978. Contract EG-77-C-01-4068. 106p. Dep. NTIS, PC A06/MF A01.

A preliminary point design configuration has been developed, based on conceptual considerations. The PHIBEX design specifications are outlined. The principal parameters are, major radius 57 cm; minor radius 22 cm; toroidal field 15.75T; plasma current of 3.3MA; copper coils, water-cooled tokamak; no auxiliary heating is incorporated in the design as this feature is not deemed necessary. Two distinct versions of PHIBEX have been detailed, PHIBEX-I has a circular cross section; PHIBEX-II has a quasi-D-shaped cross section. PHIBEX-II has been designed to have a bending-free toroidal field coil so as to minimize the stress in the coil. The plasma cross section of both PHIBEX machines are identical, and so are the rest of the plasma parameters. The point design configurations were selected in a manner consistent with both plasma physics requirements and engineering constraints. The details of the plasma physics and conceptual design considerations are presented.

44111 (DOE/TIC—4068-T1(Vol.2)) **Conceptual design of modular throwaway tokamak commerical fusion power plants for the RIGGATRON approach to fusion power. Final report.** (INESCO, Inc., Arlington, VA (USA)). 27 Apr 1978. Contract EG-77-C-01-4068. 165p. Dep. NTIS, PC A08/MF A01.

The details are discussed of the parametric analyses carried out under this program, and two detailed examples are given of canonical fusion power plants based on the RIGGATRON high-field throwaway tokamak concept. One example is an upper limit (probably physically unattainable) case, Case A, and the other is a case with more conservative (and physically realistic) scaling, Case B. The Case A system is shown solely to illustrate the absolute maximum upper performance bound of this concept, and is at or beyond currently-perceived limits of fusion plasma stability; Case B represents more realistic and conservative examples of hypothetical RIGGATRON fusion power plants as constrained by probable engineering and physics limitations. Case B also utilizes more pessimistic lower temperature cycles than Case A.

44112 (DOE/TIC—4068-T2) **Electromagnetic field and mechanical stress analysis code integration and implementation and RIGGATRON systems analysis code development.** (INESCO, Inc., Arlington, VA (USA)). 31 Jul 1978. Contract EG-77-C-01-4068. 39p. Dep. NTIS, PC A03/MF A01.

This report presents a discussion of and provides the documentation for: (1) a combined electromagnetic field analysis and mechanical stress analysis computer code used to calculate the toroidal field coil magnet stresses in threee dimensions for the RIGGATRON reactor study and; (2) the RIGGATRON systems analysis computer codes which model the interactions of the physics, engineering and economics parameter constraints of the RIGGATRON systems as the driving functions of average beta, major radius, thermal gain, and gross plant efficiency range over the parametric space of interest.

44113 (DOE/TIC—4068-T2(App.A)) **Electromagnetic field and mechanical stress analysis code.** (INESCO, Inc., Arlington, VA (USA)). 31 Jul 1978. Contract EG-77-C-01-4068. 309p. Dep. NTIS, PC A14/MF A01.

Portions of document are illegible.

Analysis TEXMAGST is a two stage linear finite element code for the analysis of static magnetic fields in three dimensional structures and associated mechanical stresses produced by the anti J x anti B forces within these structures. The electromagnetic problem is solved in terms of magnetic vector potential A for a given current density anti J as curl $1/\mu$ curl anti A = anti J considering the magnetic permeability as constant. The Coulombian gauge (div anti

A = o) was chosen and was implemented through the use of Lagrange multipliers. The second stage of the problem - the calculation of mechanical stresses in the same three dimensional structure is solved by using the same code with few modifications - through a restart card. Body forces anti J x anti B within each element are calculated from the solution of the first stage run and represent the input to the second stage run which will give the solution for the stress problem.

44114 (DOE/TIC—4068-T2(App.B)) **RIGGATRON systems analysis code.** (INESCO, Inc., Arlington, VA (USA)). 31 Jul 1978. Contract EG-77-C-01-4068. 109p. Dep. NTIS, PC A06/MF A01.

The RIGGATRON input data set and the RIGGATRON source code are given. (MOW)

44115 (EPRI-ER—1045) **Definition and conceptual design of a small fusion reactor.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1979. Contract W-7405-ENG-48. 263p. Dep. NTIS, PC A12/MF A01.

The objective of this project is to evaluate various mirror fusion reactor concepts that might result in small systems for the effective production of electrical power or stored energy (e.g., nuclear and chemical fuels). The basic two-year program goal is to select a particular concept and develop the conceptual design of a pilot plant that could provide a useful output from fusion. The pilot plant would be built and operated in the late 1980s.

44116 (EPRI-ER—1057) **Tormac fusion reactor. Final report, April 1979.** Levine, M.A.; Kunkel, W.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 73p. Dep. NTIS, PC A04/MF A01.

The work reported herein was aimed at investigating and understanding the Tormac Concept of fusion containment. Tormac (torodial magnetic cusp) is a stuffed, torodially symmetric line cusp. As a cusp, it possesses an absolute minimum-B with the advantage that it is MHD stable at high beta. For a fusion reactor, the economies and simplifications that derive from this advantage, and other Tormac characteristics, are many. The experimental program has been carried out at Lawrence Berkeley Laboratory using three devices: Tormac IV, Tormac V, and the Puffer Experiment. In Tormac IV, a high density, high beta plasma has been studied in a bicusp equilibrium. Tormac V has been used to study the start-up of Tormac. These studies have highlighted the problem of converting a Tokamak-like discharge to an absolute minimum-B geometry. The Puffer Experiment has developed a new type of plasma gun, which is used to inject a Tokamak-like plasma configuration into a Tormac geometry. The Puffer Experiment offers a natural way for Tormac start-up, and seems to solve the problems indicated by the Tormac V experiment.

44117 (ORNL/TM—6721) **Oak Ridge TNS Program: system description manual.** Reid, R.L.; Becraft, W.R.; Brown, T.G.; Peng, Y.K.M.; Sardella, C.; Shannon, T.E.; Steiner, D.; Wells, W.M.; Wiseman, G.W. (Oak Ridge National Lab., TN (USA)). May 1979. Contract W-7405-ENG-26. 98p. Dep. NTIS, PC A05/MF A01.

This document provides a systems description of the Reference Design for The Next Step (TNS) evolved at Oak Ridge National Laboratory (ORNL) during FY 1978. The description is presented on the basis of 24 individual device and facility systems. Additional information on these systems, the Reference Design, and the FY 1978 Oak Ridge TNS activities can be found in the associated technical memoranda, ORNL/TM-6720 and ORNL/TM-6722—ORNL/TM-6733.

44118 (UEC-DOE/EPRI—783112) **1978 source book for fusion—fission hybrid systems.** Crowley, J.H.; Pavlenco, G.F.; Kaminski, R.S. (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Dec 1978. Contract EN-78-C-02-4601. 43p. Dep. NTIS, PC A03/MF A01.

This study summarizes the promise and timing of the hybrid concept and culminates in a generic R and D timetable. This document emphasizes the meaningfulness of the concept to tomorrow's energy needs and energy production systems rather than strict analysis of technical feasibility. (MOW)

44119 (UWFDM—330) **NUWMAK: a tokamak reactor design study.** Badger, B.; Audenaerde, K.; Avci, H.I. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Mar 1979. Contract ET-78-S-02-4636. 756p. Dep. NTIS, PC A99/MF A01.

Detailed design information is given on the NUWMAK in each of the following chapters: (1) design philosophy of NUWMAK, (2) overview and summary of the NUWMAK design study, (3) summary of parameters, (4) plasma analysis, (5) rf heating system, (6) magnet system and energy storage, (7) blanket design, (8) neutronics analysis and radioactivity, (9) materials analysis, (10) tritium systems, (11) assembly and maintenance, (12) balance of plant, (13) materials resource analysis, and (14) system economics. (MOW)

44120 **Influence of physics parameters on tokamak reactor design.** Ehst, D.A.; Evans, K. Jr.; Stacey, W.M. Jr. (Argonne National Lab., IL). *Nucl. Technol.*; **43**: No. 1, 28-41(Apr 1979).

Twelve important tokamak reactor parameters were surveyed, and the results of sensitivity studies serve as a guide for reactor design. Numerous magnetohydrodynamic equilibria are studied to determine influences of geometry, pressure profile, safety factor, and beta on the plasma current. A steady-state transport model, which averages particle and power balances in flux space, reveals the effects of temperature and density profiles, impurities, and temperature on power density and anti n/sub i/tau. The blanket/shield thickness, major radius, and magnetic field are likewise shown to influence reactor performance.

44121 **Tandem mirror plasma confinement apparatus.** Fowler, T.K. (to Dept. of Energy). US Patent 4,125,431. 14 Nov 1978. Filed date 16 Jun 1977. 16p.

PAT-APPL-807,081.

Apparatus and method are described for confining a plasma in a center mirror cell by use of two end mirror cells as positively charged end stoppers to minimize leakage of positive particles from the ends of the center mirror cell.

BLANKET ENGINEERING

44122 (DOE/ET—0095, pp 29-33) **Results of basic research program on Li_7Pb_2.** Veleckis, E.; Maroni, V.A. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

The objective of this work is to determine the hydrogen uptake and release characteristics of selected solid lithium compounds. Estimates of the ease of removing tritium from various candidate breeders are presented.

44123 (ORNL/TM—6847) **Tokamak blanket design study: FY 78 summary report.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Jun 1979. Contract W-7405-ENG-26. 107p. Dep. NTIS, PC A06/MF A01.

A tokamak blanket cylindrical module concept was designed, developed, and analyzed after review of several existing generic concepts. The design is based on use of state-of-the-art structural materials (20% cold worked type 316 stainless steel), lithium as the breeding material, and pressurized helium as the coolant. The module design consists of nested concentric cylinders and features direct wall cooling by flowing helium between the outer (first wall) cylinder and the inner lithium containing cylinder. Each cylinder is capable of withstanding full coolant pressure for enhanced reliability. Results show that stainless steel is a viable material for a first wall subjected to 4 MW/m^2 neutron and 1 MW/m^2 particle heat flux. A lifetime analysis showed that the first wall design meets the goal of operating at 20 minute cycles with 95% duty for 10^5 cycles. The design is attractive for further development, and additional work and supporting experiments are identified to reduce analytical uncertainties and enhance the design reliability.

44124 (SAND—78-2128C) **Hydrogen retention and release in first-wall coatings for tokamaks.** Doyle, B.L.; Vook, F.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 11p. (CONF-790442—11). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

The hydrogen retention and release of two first-wall coating materials, TiB_2 and B_4C, were measured. Hydrogen is released from TiB_2 at substantially lower temperatures or laser energy fluxes (pulsed annealing) than for B_4C. Hydrogen also diffuses to a much smaller extent into TiB_2 than into B_4C. On the basis of tritium inventory control, TiB_2 appears to be superior to B_4C.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 43431, 43596, 44132

44125 (LA—77-98-MS) **Some properties of the reverse-field Z-pinch.** Gerwin, R. (Los Alamos Scientific Lab., NM (USA)). May 1979. Contract W-7405-ENG-36. 27p. Dep. NTIS, PC A03/MF A01.

The ideal MHD (macrostability) rationale for this configuration is reviewed and the associated drift velocity profiles (across and along B vector) are discussed. A new derivation of the Suydam criterion is given that clarifies the relevant physics. A number of specific examples is displayed. The drift velocity profiles are significant as regards the microstability properties of the profiles. The Suydam stability is seen to depend very sensitively on the position of the toroidal field reversal point.

44126 (SAND—79-1085C) **Numerical studies of helical CMF generators.** Freeman, J.R.; McGlaun, J.M.; Thompson, S.L.; Cnare, E.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-

76-C-04-0789. 33p. (CONF-790540—1). Dep. NTIS, PC A02/MF A01.

From 2. international conference on megagauss magnetic field generation and related topics; Washington, DC, USA (29 May 1979).

Portions of document are illegible.

The COMAG-III code has been used to model the dynamic behavior of a small CMF generator having a helical coil. The results have been compared with experiments which employed light pipe diagnostics of the explosive timing together with flash radiography to time correlate the mechanical behavior with the previously reported electrical output. The code has also been used to study and compare the importance of various loss mechanisms in these generators including ohmic heating and the flux lost be the switching action of the armature. A parameter study in which the injection current was varied is described. The possible importance of electrical breakdown is also discussed.

44127 (UCRL—15009) **Case fault analysis for the mirror fusion test facility (MFTF) magnet system.** Baldi, R.W.; Poniktera, C.D. (General Dynamics Corp., San Diego, CA (USA). Convair (Astronautics) Div.). Mar 1979. Contract W-7405-ENG-48. 46p. (GDC-LLL—79-002). Dep. NTIS, PC A03/MF A01.

This report describes the stress analysis performed to determine the criticality of selected failures in the magnet case, jacket, and intercoil member. The selected faults were idealized by adding additional nodes coincidental to existing nodes in the baseline finite element model and changing fault boundary plate connectivities. No attempt was made to alter the analysis mesh size adjacent to any fault as this degree of effort was beyond the intent and scope of this task. Results of this analysis indicated that two of the five faults analyzed would be catastrophic in nature. Faults of this cateogry were: Fault No. 1 - A weld joint failure in the minor radius 3 to 5 inch plate inter section in the chamfer region at the centerline of symmetry. Fault No. 5 - Failuree of the 3 to 5 inch transition butt weld joint at the major to minor radius transition on the magnet case top plate.

44128 (UCRL—15010) **Conductor stress analysis for the mirror fusion test facility (MFTF) magnet system.** Baldi, R.W.; Poniktera, C.D. (General Dynamics Corp., San Diego, CA (USA). Convair (Astronautics) Div.). Mar 1979. Contract W-7405-ENG-48. 48p. (GDC-LLL—79-001). Dep. NTIS, PC A03/MF A01.

This report describes the analysis performed to establish the sensitivity of winding gaps on conductor hoop stress. Since this task was a follow-on to the program that confirmed the structural integrity of the MFTF magnet case, jacket, and shield system, every effort was made to utilize analysis methods and tools developed during that program. The large, 5000 degree of freedom GDSAP model developed during that program which was used extensively throughout this analysis task is presented. This model accurately represents the case and jacket structure and simulates the conductor pack stiffness with an array of interconnected rod elements. All results contained herein are based on linear-elastic, small deflection theory. To enable us to use this analysis tool, homogenization techniques were utilized to idealize the non-linear gap problem into a linear problem compatible with our existing analysis techniques. Details of the homogenization are presented.

44129 Design and development of cryostable superconducting ohmic heating coils for a tokamak. Wang, S.T.; Kim, S.H.; Turner, L.R.; Thompson, K.M.; Praeg, W.F.; Krieger, C.I.; Kustom, R.L. (Argonne Natl Lab, Ill). *Adv. Cryog. Eng.;* **23**: 255-264(1977).

A conceptual design on the superconducting ohmic heating (OH) coil has been made for the GA/ANL TNS tokamak reactor studies. The primary advantage of a superconducting OH coil is the minimization of equipment and operational costs. This is primarily a result of the much reduced power supply and energy storage costs. The design and construction of a prototype pulsed coil and its nonmetallic cryostat are presented.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 43130

44130 (LA-UR—79-1064) **Flux compression generators as plasma compression power sources.** Fowler, C.M.; Caird, R.S.; Erickson, D.J.; Freeman, B.L.; Thomson, D.B.; Garn, W.B. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 25p. (CONF-781247—1). Dep. NTIS, PC A02/MF A01.

From 2. international conference on energy storage, compression and switching; Venice, Italy (5 Dec 1978).

A survey is made of applications where explosive-driven magnetic flux compression generators have been or can be used to directly power devices that produce dense plasmas. Representative examples are discussed that are specific to the theta pinch, the plasma gun, the dense plasma focus and the Z pinch. These examples are used to illustrate the high energy and power capabilities of explosive generators. An application employing a rocket-borne, generator-powered plasma gun emphasizes the size and weight potential of flux compression power supplies. Recent results from a local effort to drive a dense plasma focus are provided. Imploding liners ae discussed in the context of both the theta and Z pinches.

44131 (LA-UR—79-1436) **High-density Z-pinch pulse-power supply system.** Nunnally, W.C.; Jones, L.A.; Singer, S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-790622—2). Dep. NTIS, PC A02/MF A01.

From Pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The design and operation of the high-density Z-pinch experiment pulse-power supply is discussed. A 600-kV, 1-MA, 75-nH Marx bank is designed to charge a 1-Ω, 90-ns, water-insulated transmission line to ~ 0.6 to 1.0 MV. The water line is then discharged through a small laser-initiated current channel in 1 to 5 atm of hydrogen. The components of the Marx bank, the trigger system, the water line, and the gas load as well as the control system that uses fiber optics and air links for monitor and control are discussed.

44132 (UCRL—50025-79-1, pp 4-13) **Electronic control system developed for tandem mirror experiment (TMX) magnets.** 30 Mar 1979.

In Electronics engineering department. Quarterly report No. 1, 1979.

As researchers in the magnetic fusion energy program strive to achieve fusion power through magnetic confinement, the experiments increase in size and complexity. The tandem mirror experiment (TMX), which is nearing completion, requires 20 MW of pulsed dc power to drive its magnet set. Although the 18 coils that make up the magnet system have a fixed physical geometry, we can produce a range of magnetic flux shapes by adjusting the current in individual coils. We have developed an electronic control system for the TMX magnets that monitors magnet coil operation and controls the power supplies that drive the magnets. The center of the control system is an LSI-11 microcomputer.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 44161

HEATING AND FUELING SYSTEMS

44133 (DOE/ET—0095, pp 1-15) **Neutronic performance of candidate tritium breeding materials.** Jung, J.C. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

The objective of this study was to compare the tritium breeding characteristics of Li, Li_2O and Li_7Pb_2 as a function of blanket thickness, structural content and coolant choice. The Li_7Pb_2 compound was found to give slightly higher breeding ratios than pure lithium and significantly higher rates than did Li_2O. The Li_2O blankets did reach their full breeding capability at smaller thicknesses due to moderation of the neutron spectrum by the oxygen. Due to this moderation inherent to the use of Li_2O, the incorporation of a carbon reflector did not improve the performance of the Li_2O blanket nearly as much as it did the performance of the Li_7Pb_2 and Li blankets. Very little incentive for enriching any of the breeders with Li-6 was found.

44134 (DOE/ET—0095, pp 17-23) **Experiment to measure the tritium and helium release rates from neutron irradiated Li_7Pb_2.** Hall, M.M. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

The objective of this work is to experimentally measure the tritium and helium release rates from neutron irradiated Li_7Pb_2. An irradiation experiment to determine the partitioning of tritium and helium between solid Li_7Pb_2 breeding material, a zircaloy getter and a stainless steel capsule have been designed for possible insertion into the ORR reactor.

44135 Acceleration of solid pellets using a plasma gun. Buller, T.L.; Turnbull, R.J.; Kim, K. (Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801). *Appl. Phys. Lett.;* **34**: No. 12, 826-828(15 Jun 1979).

The use of solid pellets of hydrogen isotopes to refuel thermonuclear fusion reactors based on the tokamak configuration will require that the pellets be accelerated to high velocities. One possible method of acceleration is to interact a fast plasma from a plasma gun with the pellets. In this paper preliminary results are given on the acceleration of solid pellets with a plasma gun. The plasma-gun requirements for successful acceleration to high velocities are discussed.

44136 Fuel preconditioning studies for e-beam fusion targets. Olsen, J.N.; Widner, M.M.; Chang, J.; Baker, L. (Sandia Laborato-

ries, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **50**: No. 5, 3224-3230(May 1979).

Fuel temperature and density conditions, achieved during the preheat phase of electron-beam fusion compression experiments, must be accurately known to understand experimental results via numerical simulations. We present studies of discharge preheating in a simplified cylindrical geometry which compare measured quantities with results from the one-dimensional Lagrangian CHARTB magnetohydrodynamic code. Experimental measurements included schlieren photography and ultraviolet through visible time- and space-resolved spectroscopy in various configurations. It is seen that an 8-kA 500-ns heating pulse in 100 Torr of $D_2+10\%$ O_2 produces 10—12 eV temperatures, 10^{18} cm^{-3} electron densities, and 7 x 10^5 cm/s expansion velocities in the heated discharge channel. These results are consistent with previous claims for neutron-producing targets, although the target geometry is different.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 44137

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 42375, 43590, 43610, 44166

44137 (LA—7778-MS) **MHD deceleration of fusion reaction products.** Chow, S.; Bohachevsky, I.O. (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

The feasibility of magnetohydrodynamic (MHD) deceleration of fuel pellet debris ions exiting from an inertial confinement fusion (ICF) reactor cavity is investigated using one-dimensional flow equations. For engineering reasons, induction-type devices are emphasized; their performance characteristics are similar to those of electrode-type decelerators. Results of the analysis presented in this report indicate that MHD decelerators can be designed within conventional magnet technology to not only decelerate the high-energy fusion pellet debris ions but also to produce some net electric power in the process.

44138 (LA-UR—79-432) **Loads and stresses in ICF reactors.** Bohachevsky, I.O.; Booth, L.A.; Frank, T.G.; Pendergrass, J.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-790802—14). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

The loads on inertial confinement fusion (ICF) reactor vessel walls resulting from anticipated operating conditions will be in the form of very intense but short duration mechanical and thermal pulses. In this paper these pulses are modeled and the magnitudes of the associated impulses are estimated. Stresses induced in the containment vessel walls are determined using engineering stress analysis. Simplifying assumptions required to derive analytic expressions for loads and stresses are made and the results are presented in the form convenient for parametric studies and determinations of design sensitivities to changes in different parameters. The results indicate that dominating mechanical design constraints will be determined most likely by evaporation recoil and elastic buckling and that thermally excited stress waves may determine critical design requirements. The analysis of ICF reactor vessel loads and stresses summarized here also led to identification of technical topics that require additional theoretical and experimental studies for better ICF reactor modeling and more accurate assessment of their economic potential.

44139 (LA-UR—79-1420) **Optical design and analysis of carbon dioxide laser fusion systems using interferometry and fast Fourier transform techniques.** Viswanathan, V.K. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790529—2). Dep. NTIS, PC A02/MF A01.

From Conference on Optics; Los Alamos, NM, USA (23 May 1979).

The optical design and analysis of the LASL carbon dioxide laser fusion systems required the use of techniques that are quite different from the currently used method in conventional optical design problems. The necessity for this is explored and the method that has been successfully used at Los Alamos to understand these systems is discussed with examples. This method involves characterization of the various optical components in their mounts by a Zernike polynomial set and using fast Fourier transform techniques to propagate the beam, taking diffraction and other nonlinear effects that occur in these types of systems into account. The various programs used for analysis are briefly discussed.

44140 (NVO—1555-4) **Development of fluorides for high power laser optics. Quarterly technical progress report, 1 January 1979—31 March 1979.** Ready, J.F.; Vora, H. (Honeywell Corporate Research Center, Bloomington, MN (USA)). Apr 1979. Contract ET-78-C-08-1555. 6p. Dep. NTIS, PC A02/MF A01.

This report describes continued development of LiF as a material with low nonlinear refractive index and high ultraviolet transmission as a material for use in the laser fusion program. LiF single crystals are forged under isostatic helium constraint to form fine-grained window blanks. This report presents results on multistep forging of LiF to increase the percentage reduction that can be imparted to the starting material. It also describes calorimetric measurement of the absorption coefficient of LiF at 1.06 μm. Our first attempts to forge KTb_3F_{10}, a Faraday rotator material, are discussed.

44141 (SAND—79-0600C) **Sandia's Particle Beam Fusion Program.** Sweeney, M.A. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 38p. (CONF-790466—1). Dep. NTIS, PC A03/MF A01.

From Idaho section of American Society of Mechanical Engineers--fusion energy symposium; Idaho Falls, ID, USA (19 Apr 1979).

Portions of document are illegible.

Sandia's Particle Beam Fusion Program is investigating pulsed electron and light ion beam accelerators, with the goal of demonstrating the practical application of such drivers as igniters in inertial confinement fusion (ICF) reactors. Recent developments in the program are described. Traditionally, two requirements of ICF reactor operation have been the most difficult to satisfy in conceptual designs. Adequate standoff of critical components from damaging pellet emissions must be assured, and the shot repetition rate must be consistent with the desired reactor power level at reasonable pellet gains. Progress in power compression, beam focusing and transport, first-wall protection schemes, and net-energy-gain target design shows how these requirements can be met.

44142 (UCRL—50021-77(Vol.1)) **Laser program annual report, 1977. Volume 1.** Bender, C.F.; Jarman, B.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 357p. Dep. NTIS, PC A16/MF A01.

An overview is given of the laser fusion program. The solid-state program covers the Shiva and Nova projects. Laser components, control systems, alignment systems, laser beam diagnostics, power conditioning, and optical components are described. The fusion experimental program concerns the diagnostics and data acquisition associated with Argus and Shiva. (MOW)

44143 (UCRL—50021-77(Vol.2)) **Laser program annual report, 1977. Volume 2.** Bender, C.F.; Jarman, B.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 447p. Dep. NTIS, PC A19/MF A01.

This volume contains detailed information on each of the following sections: (1) fusion target design, (2) target fabrication, (3) laser fusion experiments and analysis, (4) advanced lasers, (5) systems and applications studies, and (6) laser isotope separation program. (MOW)

44144 (UCRL—81327) **Double-shelled target simulations with LASNEX.** McClellan, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1978. Contract W-7405-ENG-48. 19p. (CONF-781053—13). Dep. NTIS, PC A02/MF A01.

From APS plasma physics meeting; Colorado Springs, CO, USA (30 Oct 1978).

Double-shelled inertial confinement fusion targets in which the outer shell is exploded have been studied with LASNEX. To achieve high DT density, configurations have been found in which the inner shell is ablatively driven by the hot outer shell. Calculations indicate that greater than 100 times liquid DT density can be achieved with the Shiva laser while still retaining some of the symmetry and stability advantages of the single-shelled exploding pusher target. The relative merits of transferring energy to the inner shell by electron conduction and by hydrodynamic work will be discussed.

44145 (UCRL—81826) **Viscous effects on a turbulent jet near nozzle exit.** Kang, S.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1979. Contract W-7405-ENG-48. 8p. (CONF-790153—1). Dep. NTIS, PC A02/MF A01.

From Annual meeting of the APS; New York, NY, USA (29 Jan 1979).

Analysis is made of the viscous effects on changes in the velocity profile of an incompressible turbulent jet exhausting into an immiscible ambient medium. Under some simplifying conditions, a closed-form solution is obtained. The results demonstrate possible retardation of turbulent jet breakup due to viscous effects.

44146 (UCRL—82026) **Fusion target design.** Bangerter, R.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Dec 1978. Contract W-7405-ENG-48. 49p. (CONF-7806114—2). Dep. NTIS, PC A03/MF A01.

From Faculty Institute, Inertial Confinement Fusion; Argonne, IL, USA (5 Jun 1978).

Most detailed fusion target design is done by numerical simulation using large computers. Although numerical simulation is briefly discussed, this lecture deals primarily with the way in which basic physical arguments, driver technology considerations and economical power production requirements are used to guide and augment the simulations. Physics topics discussed include target energetics, preheat, stability and symmetry. A specific design example is discussed.

44147 (WARD-LI—1570-1) **Lithium vapor/aerosol studies. Interim summary report.** Whitlow, G.A.; Bauerle, J.E.; Down, M.G.; Wilson, W.L. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Apr 1979. Contract ED-78-C-08-1570. 35p. Dep. NTIS, PC A03/MF A01.

The temperature/cover gas pressure regime, in which detectable lithium aerosol is formed in a static system has been mapped for argon and helium cover gases using a portable He—Ne laser device. At 538°C (1000°F), lithium aerosol particles were observed over the range 0.5 to 20 torr and 2 to 10 torr for argon and helium respectively. The experimental conditions in this study were more conducive to aerosol formation than in a fusion reactor. In the real reactor system, very high intensity mechanical and thermal disturbances will be made to the liquid lithium. These disturbances, particularly transient increases in lithium vapor pressure appear to be capable of producing high concentrations of optically-dense aerosol. A more detailed study is, therefore, proposed using the basic information generated in these preliminary experiments, as a starting point. Areas recommended include the kinetics of aerosol formation and the occurrence of supersaturated vapor during rapid vapor pressure transients, and also the effect of lithium agitation (falls, jets, splashing, etc.) on aerosol formation.

44148 Producion of intense focused ion beams in a spherical magnetically insulated diode. Greenspan, M.; Hammer, D.A.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *J. Appl. Phys.;* **50**: No. 5, 3031-3038(May 1979).

A magnetically insulated ion diode has been constructed with a spherically focusing geometry. The diode has been operated at voltages of ~250 and ~500 kV, with impedances adjusted to 2—3 and 7—10 Ω, respectively. The pulse length was ~85 ns. Total ion currents were > or =30% of the diode current. In the high-voltage case, a focal current density of 2100 A/cm² was obtained; this is > or ≈90 times the anode ion current density. Auxilliary magnetic fields were used to steer the beam, with the beam deflection as calculated for a single proton. The diode design and diagnostic techniques are described, as well as possibilities for improvements suggested by our data.

44149 Propagation of power pulses in magnetically insulated vacuum transmission lines. Di Capua, M.S.; Pellinen, D.G. (Physics International Company, San Leandro, California 94577). *J. Appl. Phys.;* **50**: No. 5, 3713-3720(May 1979).

The propagation of a 1.8-MV 80-kA power pulse in a 10-m-long 41.6-Ω impedance coaxial vacuum transmission line has been investigated experimentally. The onset of magnetic insulation has been correlated to attainment of the critical current. Measurements of boundary (cathode) current suggest that 50—60% of the current flows in space charge in the axial direction between the conductors. The pulse sharpens as it propagates and attains a stationary shape. Pulse rise times of 4 ns were observed. Propagation velocities equal to 0.7c have been measured. Power and energy transports as high as 90 and 70% have been observed. The peak power density in the transmission line was 2×10^9 W cm^{-2}.

44150 Engineering problems of laser-driven fusion reactors. Abdel-Khalik, S.I.; Conn, R.W.; Moses, G.A. (Univ. of Wisconsin, Madison). *Nucl. Technol.;* **43**: No. 1, 5-21(Apr 1979).

The University of Wisconsin fusion reactor study group has completed a study of laser fusion reactor problems incorporated into a self-consistent reactor design, SOLASE. The purpose of the SOLASE study is to identify and quantitatively analyze the major technological features posed by laser fusion reactors, to assess the relative advantages and prospective problems, and to guide further research. The engineering problems examined in the SOLASE study include first wall design and protection, radiation damage and materials constraints, compatibility of first wall and pellet materials, placement and protection of the last optical elements, pellet injection requirements, tritium breeding and blanket design concepts, vacuum pumping requirements, heat removal and power cycle considerations, recirculating power requirements, and shielding and primary containment considerations. Other conceptual reactor designs have also been examined and critically compared.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 43392, 43397, 43407, 43411, 43424, 43425, 43426, 43427, 43429, 43430, 43432, 43436, 43443, 43444, 43445, 43455, 43456, 43457, 43458, 43459, 43460, 43461

44151 (ANL/FPP/TM—86) **Austenitic stainless steel bulk property considerations for fusion reactors.** Mattas, R.F. (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 41p. Dep. NTIS, PC A03/MF A01.

The bulk properties of annealed 304, 316, and 20% cold-worked 316 stainless steels are evaluated for the temperature and radiation conditions expected in a near-term fusion reactor. Of interest are the thermophysical properties, void swelling produced by neutron radiaion, and the tensile, creep, and fatigue properties before and after irradiation.

44152 (BNL—25792) **Calculation of radiation damage in insulators for fusion reactors.** Dell, G.F.; Berry, H.C.; Goland, A.N.; Lazareth, O.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790125—62). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

The MORSE neutron transport code has been used to characterize the neutron and gamma ray fluxes in a typical irradiation cave from a Li(d,n) neutron source. Recoil-atom damage and gas generation have been evaluated for Al_2O_3 and Si_3N_4 using the damage program DON.

44153 (BNL—25812) **Performance of ceramic materials in high temperature steam and hydrogen.** Horn, F.L.; Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-790125—56). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Materials considered for use in fusion blankets for synthetic fuel production were exposed to flowing steam and a combination of steam and hydrogen at temperatures up to 1668 K and flow velocities of 10 meters per second, which are characteristic of proposed blanket conditions. The penetration rate of 2mm per year for silicon carbide in steam at 1400 K increased to 6mm per year at 1600 K, while rates for alumina, zirconia, and magnesia were below 0.1mm per year. Steam containing 32 to 44 volume percent hydrogen caused a large increase in the erosion rate of aluminia, zirconia, and magnesia at elevated temperatures. The temperature above which the erosion rate greatly increased was 1400 K for magnesia, 1550 K for alumina, and 1600 K for zirconia. The penetration rates below these temperatures were less than 0.1mm per year; however, 100 K above these temperatures, the penetration rate increased four to six times and continued to increase with temperature. The erosion rate of silicon carbide was unaffected by the presence of hydrogen in the steam. Carbon dioxide was substituted for steam and hydrogen in several runs up to 1670 K, and no significant weight losses occurred. The silicon carbide acquired a porous-glassy coating at the highest temperature.

44154 (CONF-790125—63) **Defect production and electronic stopping for light ions in metals.** Averback, R.S.; Benedek, R.; Merkle, K.L.; Thompson, L.J. (Argonne National Lab., IL (USA)). 1979. Contract W-7405-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

A method for determining effective electronic stopping powers in metals is presented. The method involves measuring damage rates in thin films as a function of ion energy. The experimental results are compared with predictions based on Monte Carlo computer simulations. Results are presented for H, D, He, and Li projectiles on Cu, Ag, and Ni. The implication of these results for defect production is discussed.

44155 (CONF-790125—66) **Damage of niobium surfaces caused by bombardment with $^4He^+$ ions of different energies typical for T-20.** Guseva, M.I.; Gusev, V.; Martynenko, Yu.V.; Das, S.K.; Kaminsky, N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii; Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

The surface damage of cold worked and annealed polycrystalline Nb irradiated at room temperature with He^+ ions sequentially at different energies over the range from 0.5 keV to 1.8 MeV has been investigated. The individual energy and the dose of the He^+ ion was chosen to match the theoretically calculated He^+ ion spectrum expected in the Tokamak T-20. In one set of irradiations, targets were irradiated at Kurchatov Institute starting with 0.5 keV $^4He^+$

ions and extending up to 90 keV in eleven steps. Subsequently, the same area was irradiated at ANL starting at 150 keV and increased in eight steps up to 1.8 MeV. The irradiations were carried out for a total dose of 5.0 C/cm². In another set of irradiations the sequence was reversed. Scanning electron microscopy results show formation of blisters and exfoliation. For the same dose the broad energy implant (due to sequential irradiation) appears to decrease the blister diameter and density as compared to irradiation with monoenergetic He^+ ions at a given energy (in the energy range considered). Some estimates of surface erosion yields due to blistering are given.

44156 (CONF-790125—67) **Effect of dose on the evolution of cavities in 500-KeV $^4He^+$-ion irradiated nickel.** Fenske, G.; Das, S.K.; Kaminsky, M.; Miley, G.H. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). 1979. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Transmission electron microscopy has been used to investigate the effect of total dose on the depth distribution of cavities (voids or bubbles) in nickel irradiated at 500°C with 500-keV $^4He^+$ ions. A transverse sectioning technique, which allows one to obtain the entire depth distribution of cavities and of damage from a single specimen, was utilized. The size, number density and volume fraction of bubbles or voids were measured from the micrographs taken from samples sectioned parallel to the direction of the incident beam. The results for the dose range studied (2×10^{19} to 1×10^{21} ions/m²) show that the average cavity diameter, number density, and the volume fraction (i.e., swelling) increases with increasing dose. The peak in the swelling distribution occurs at depths 8 to 15% deeper than the peak in the calculated projected range profile.

44157 (CONF-790125—68) **Surface damage and sputtering of ATJ graphite as candidate armor plate material for TFTR under D^+ bombardment.** Das, S.K.; Kaminsky, M.; Tishler, R. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Experiments have been conducted to determine surface damage and total sputtering yields of ATJ graphite (a candidate armor plate material) caused by D^+ ion irradiation at 40-, 60-, and 120-keV for fluxes close to those expected to reach the armor plate during the operation of neutral beam injectors used for the Tokamak Fusion Test Reactor (TFTR). The irradiations for surface damage studies were conducted both in the pulsed mode and in the continuous mode. Scanning electron microscopy of irradiated surfaces revealed surface damage in the form of ridges and grooves for both pulsed and continuous irradiations. Total sputtering yields for ATJ graphite samples which reached surface temperatures characteristic for given beam power depositions are given for 40-, 60-, and 120-keV D^+ irradiations at normal incidence.

44158 (CONF-790125—69) **Surface damage of TiB_2 and C coatings under energetic D^+ and $^4He^+$ irradiations.** Kaminsky, M.; Das, S.K. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Studies of the surface damage and erosion of chemically vapor deposited (CVD) TiB_2 and C coatings on metallic substrates are reported for irradiation with 5 to 20 keV and 100 keV D^+ and $^4He^+$ ions for different doses at room temperature. Furthermore, D^+ and He^+ irradiations of commercial grade Ti and ATJ graphite were conducted to study the difference in surface damage and erosion between the TiB_2 coatings and Ti metal, and between the CVD carbon coating and extrusion molded ATJ graphite. SEM analysis of polished TiB_2 and Ti samples after irradiation with D^+ and $^4He^+$ ions with energies at 10, 15, 20 and 100 keV to a dose of 3.1×10^{18} ions/cm² reveal significant surface damage due to blistering. D^+ irradiation of the as received carbon coatings for energies of 10 to 20 keV to a dose of 3.1×10^{18} ions/cm² revealed no surface blisters or major surface damage whereas the He^+ irradiation showed some growth features on the surface. In contrast, 10 to 20 keV D^+ irradiated ATJ graphite revealed large ridges and grooves on the irradiated surface, and 10 to 20 keV He^+ irradiated surfaces showed pitting.

44159 (COO—4393-03) **Damage of metal surfaces by a hot, dense deuterium plasma.** Panayotou, N.F. (Columbia Univ., New York (USA). School of Engineering and Applied Science). 1978. Contract EG-77-S-02-4393. 96p. Dep. NTIS, PC A05/MF A01.

The effect of differences in alloy chemistry and systematic changes in microstructural interface density on the occurrence of unipolar arcing was studied. The effect of thermionic emission is examined by comparing the refractory metals W, Nb, and Nb-751 alloy to the non-refractory stainless steels, AISI 304, 316 and Nimonic PE-16. The effect of alloying additions is examined by comparing Mo containing 316 and Mo free 304 stainless steels as well as Zr containing Nb-751 and Zr free Nb. The effect of interface density is examined by systematically varying the density of microstructural interfaces in AISI 4130, a ferritic steel. Although most of the metals and alloys studied are candidate fusion reactor materials, 4130 was chosen on the basis of our ability to modify the density of microstructural interfaces in the material by heat treatment. The results are discussed with respect to available unipolar arcing theory. The significance of the work, in terms of actual power reactors is assessed and the need for further work defined.

44160 (DOE/ET—0095) **Special purpose materials. Annual progress report.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1979. 126p. Dep. NTIS, PC A07/MF A01.

Separate abstracts were prepared for each of the included papers. (MOW)

44161 (DOE/ET—0095, pp 25-28) **Compatibility considerations for the use of solid breeders.** Clemmer, R.G.; Smith, D.L. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

The objective of this work is to assess the expected chemical compatibility of various coolant, structural and breeder combinations. Several different candidate structural materials are rated as to their compatibility with different candidate coolants. It is noted that the use of solid breeders such as Li_7Pb_2 or Li_2O demands that they be clad if they are to be used with either water or hitech salt. Tritium inventories have been calculated for different coolant—breeder combinations. Molten salt extraction from a liquid lithium breeder should result in concentrations of 1 wppM or in total blanket inventories of 0.1 to 1.0 kg. Inventory levels of $\sim$ 1 kg of tritium are extimated for either solid breeder, Li_2O or Li_7Pb_2.

44162 (DOE/ET—0095, pp 85-90) **Radiation effect consideration in the design of diagnostic windows for TFTR.** Primak, W. (Argonne National Lab., IL). May 1979.

In Special purpose materials. Annual progress report.

Vitreous silica, crystal quartz and synthetic sapphire have been considered for use in TFTR diagnostic windows. The major problems presented by the TFTR environment result from the effects of soft x rays. In vitreous silica the expected soft x-ray flux is expected to induce surface crazing to an extent that will make coverslip protection necessary.

44163 (EPRI-ER—1046) **Fusion reactor remote maintenance study. Final report.** Sniderman, M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Apr 1979. 387p. Dep. NTIS, PC A17/MF A01.

An analysis of a major maintenance operation, the remote replacement of a modular sector of a tokamak reactor, was performed in substantial detail. Specific assumptions were developed which included concepts from various existing designs so that the operation which was studied includes some design features generic to any fusion reactor design. Based on the work performed in this study, the principal conclusions are: (1) It appears feasible to design a tokamak fusion reactor plant with availability comparable to existing fossil and fission plants, but this will require diligence and comprehensive planning during the complete design phase. (2) Since the total fusion program is paced by the success of each device, maintenance considerations must be incorporated into each device during design, even if the device is an experimental unit. (3) Innovative approaches, such as automatic computer controlled operations, should be developed so that large step reductions in planned maintenance times can be achieved.

44164 (GA-A—15276) **Materials implications of fusion-fission reactor designs.** Schultz, K.R. (General Atomic Co., San Diego, CA (USA)). Jan 1979. Contract EY-76-C-03-0167-038. 12p. (CONF-790125—65). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

The fusion-fission reactor concept is briefly reviewed. The potential operating modes for fusion-fission systems are reviewed with emphasis on their materials environments, and the materials implications of the assumed mainline fuel producing hybrid are discussed from the reactor designer's point of view. The impact of materials performance on hybrid reactor design is assessed and it is suggested that although materials performance is of vital concern and further materials evaluation work is needed, the materials requirements of the hybrid are an overlap of fusion and fission requirements and appear to be less demanding than those of fission and fusion systems alone.

44165 (GA-A—15356) **Application of martensitic stainless steels in long lifetime fusion first wall/blankets.** Rosenwasser, S.N.; Miller, P.; Dalessandro, J.A.; Rawls, J.M.; Toffolo, W.E.; Chen, W. (General Atomic Co., San Diego, CA (USA)). Mar 1979. Contract EY-76-

C-03-0167-038. 11p. (CONF-790125—55). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

An assessment is made of the feasibility and design impact of using a ferromagnetic martensitic steel such as HT-9 in first wall/blanket structures. A preliminary analysis indicates that HT-9 may offer significantly greater wall lifetimes than 20CW316 for temperatures below about 520°C. A number of exploratory measurements and rough calculations suggest that the presence of ferromagnetic material does not significantly affect the operational characteristics of tokamak power reactors.

44166 (LBL—8643) **Development of large rectangular ceramic insulators for ion accelerators for the neutral-beam program.** Paterson, J.A.; Koehler, G.W.; Duffy, T.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 6p. (CONF-790125—48). Dep. NTIS, PC A02/MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

The need for structures that are resistant to damage for 14 MeV neutrons, are bakeable, and that can be closely packed together, has resulted in the intensive development of rectangular brazed ceramic insulators for ion accelerators. The development of two candidate materials, machinable glass ceramic and alumina, is described along with the ceramic-to-metal brazing techniques developed for each material. The microstructures of the brazed joints are examined and the results of microprobe studies presented. It has been found that the surfaces produced by different machining methods have a significant effect on the strength of brazed joints to the machinable glass ceramic. Lapped surfaces have given bond strengths up to three times those produced with other surfaces. Successful full-size brazes have been realized between alumina and titanium and between machinable glass and titanium. Vacuum tight joints between machinable glass and titanium have not been reliably achieved and more work is needed before brazing techniques to this promising new material are fully understood.

44167 (SAND—78-2101C) **Plasma-sprayed coatings for fusion reactor applications.** Mullendore, A.W.; Mattox, D.M.; Whitley, J.B.; Sharp, D.J. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 13p. (CONF-790442—7). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

A series of plasma-sprayed coatings has been given a preliminary evaluation to assess the potential of this class of materials in fusion reactor applications. TiC, TiB_2, Be and VBe_{12} coatings on copper and stainless steel were tested for coating adherence, ion erosion resistance and susceptability to arc erosion. The coatings, in general, display a good resistance to thermal shock failure. The TiC and TiB_2 coatings exhibit favorable ion erosion characteristics and the resistance of the coatings to arc erosion was, in general, superior to that of stainless steel.

44168 (SAND—78-2135C) **Boron coatings on graphite for fusion reactor applications.** Pierson, H.O.; Mullendore, A.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract AC04-76DP00789. 11p. (CONF-790442—10). Dep. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

This study is an experimental investigation of boron coatings on graphite and the preliminary determination of some of their physical and nuclear related properties. The boron was obtained by the decomposition of diborane in argon at 500°C and one atm. Adhesion to the graphite (POCO AXF-5Q) was good if a slightly abraded surface was provided. The boron was pseudo-amorphous, had high purity with no visually observable porosity and the fractured surface showed no growth features. It was very hard (VHN_{25} = 2400 kg/mm²) and had good resistance to hydrogen ion erosion and arcing. It may, therefore, be a suitable candidate for first wall and limiter coatings in tokamak fusion reactors.

44169 **Shock-tube study of fusion plasma-wall interactions.** Gross, R.A.; Tien, J.K.; Jensen, B.; Panayotou, N.F.; Feinberg, B. (Columbia Univ., New York, NY). pp 588-594 of Shock tube and shock wave research. Ahlborn, B.; Hertzberg, A.; Russell, D. (eds.). Seattle, WA; University of Washington Press (1978).

From 11. international symposium on shock tubes and waves; Seattle, WA, USA (11 Jul 1977).

Theoretical and experimental studies have been made of phenomena which occur when a hot ($T_i \approx 6 \times 10^6$ °K), dense ($n \approx 10^{16}$ cm^{-3}), deuterium plasma containing a transverse magnetic field is brought into sudden contact with a cold metal wall. These studies are motivated by the need to understand plasma and metallurgical conditions at the first-wall of a fusion reactor. Experiments were carried out in the Columbia high energy electromagnetic shock tube. Computational simulation was used to investigate the detailed physics of the fusion plasma boundary layer which develops at the wall. The rate of energy transfer from the plasma to the wall was calculated and conditions under which surface melting occurs are estimated. Experimental measurements of plasma-wall heat transfer rates up to 3×10^5 watts/cm² were obtained and agreement with computed values are good. Fusion reactor first-wall materials have been exposed to 6.0×10^{21} eV cm^{-2} (1,000 shots) of deuterium plasma bombardment. Scanning electron micrograph photographs show preferential erosion at grain boundaries, formation of deuterium surface blisters, and evidence of local surface melting. Some cracking is observed along grain boundaries, and a decrease in tensile ductility is measured.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 43202

44170 (DOE/ER—0028) **Basic research projects.** (Department of Energy, Washington, DC (USA)). Apr 1979. 38p. Dep. NTIS, PC A03/MF A01.

The research programs under the cognizance of the Office of Energy Research (OER) are directed toward discovery of natural laws and new knowledge, and to improved understanding of the physical and biological sciences as related to the development, use, and control of energy. The ultimate goal is to develop a scientific underlay for the overall DOE effort and the fundamental principles of natural phenomena so that these phenomena may be understood, and new principles, formulated. The DOE-OER outlay activities include three major programs: High Energy Physics, Nuclear Physics, and Basic Energy Sciences. Taken together, these programs represent some 30 percent of the Nation's Federal support of basic research in the energy sciences. The research activities of OER involve more than 6,000 scientists and engineers working in some 17 major Federal Research Centers and at more than 135 different universities and industrial firms throughout the United States. Contract holders in the areas of high-energy physics, nuclear physics, materials sciences, nuclear science, chemical sciences, engineering, mathematics geosciences, advanced energy projects, and biological energy research are listed. Funding trends for recent years are outlined. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 42186, 42429, 42430, 43661, 44065

44171 (BNL—25939) **Multiple customer-class LBPS queueing discipline.** Noetzel, A.S. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-790359—1). Dep. NTIS, PC A02/MF A01.

From Conference on information sciences and systems; Baltimore, MD, USA (28 Mar 1979).

Portions of document are illegible.

Generalizations of classical results in the theory of queueing networks have shown that the product form network solution is obtained for general service distributions at the queues, as long as the discipline at each queue is one of a few specific types. Recently, the Last Batch/Processor Sharing (LBPS) discipline has been introduced as a parameterized discipline that preserves the product form property, and includes the known product form-preserving disciplines as special cases.

44172 (CONF-790471—1) **User perspectives on computer applications.** Trammell, H.E. (Oak Ridge National Lab., TN (USA)). Apr 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From 20. association for ERDA systems, operations and programming meeting; Gatlinburg, TN, USA (25 Apr 1979).

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Experiences of a technical group that uses the services of computer centers are recounted. An orientation on the ORNL Engineering Technology Division and its missions is given to provide background on the diversified efforts undertaken by the Division and its opportunities to benefit from computer technology. Specific ways in which computers are used within the Division are described; these include facility control, data acquisition, data analysis, theory applications, code development, information processing, cost control, management of purchase requisitions, maintenance o personnel information, and control of technical publications. Prob lem areas found to need improvement are the overloading of com

puters during normal working hours, lack of code transportability, delay in obtaining routine programming, delay in key punching services, bewilderment in the use of large computer centers, complexity of job control language, and uncertain quality of software. 20 figures. (RWR)

44173 (CONF-790525—1) **Influence of microprocessor technology on instrument and system design.** Johnson, M.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 18p. Dep. NTIS, PC A02/MF A01.

From 8. IMEKO congress; Moscow, USSR (21 May 1979).

Current microprocessor technology as it relates to the design of instruments and instrumentation and control systems is surveyed. Because of fast-paced technological advances, design philosophies must change. The engineer's role and the tools he uses are also changing. The processing power of today's microprocessors and modular microcomputers is sufficient to satisfy a very wide class of instrument and control system requirements. In fact, the constraint is identifying imaginative problems rather than developing solutions. Current representative applications of microprocessors are examined, including some implemented at the Idaho National Engineering Laboratory (INEL). Future trends in LSI product capability, programming languages, standardization, and applications such as intelligent transducers and distributed processing systems are considered.

44174 (CONF-7805149—2) **What will your time series analysis computer package do: computer packages.** Pack, D.J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

From IMS special topics meeting on time series analysis; Ames, IA, USA (1 May 1978).

A survey of existing time series analysis computer packages is presented. The primary emphasis is on packages relating to the ARIMA model building process and packages that are non-spectral. The survey is segmented into general purpose standard statistical packages (BMDP, IMSL, SAS, SPSS), many method packages, and integrated ARIMA model building packages. Likely new directions are discussed. A number of concerns arise as a result of the survey, relating to the absence of time series capabilities in the standard statistical packages, the definition of an optimal method, the supply of computer packages from the academic to the business environment, and the degree of computerization appropriate for time series analysis.

44175 (GEPP—342) **Microprocessor applications.** Wedel, T.A. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1977. Contract EY-76-C-04-0656. 35p. (CONF-7710181—1). Dep. NTIS, MF A01.

From 3. test methodology information exchange program conference; Kansas City, MO, USA (11 Oct 1977).

Portions of document are illegible.

Four applications of microprocessor control are given. These are: microprocessor controlled drilling station for machining parts; a heat controller to control the temperature of a vacuum oven; a process controller for a vacuum process in a manufacturing operation; and a glass-sealing furnace temperature controller. The control hardware is shown and program flow diagrams are given. (GHT)

44176 (LA-UR—79-251) **Lie-group theory for symbolic integration of first-order differential equations: a modern treatment.** Beyer, W.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 35p. (CONF-790629—2). Dep. NTIS, PC A03/MF A01.

From 2. MACSYMA users conference; Washington, DC, USA (20 Jun 1979).

A review of the present status of the application of Lie-group theory to the solution of first-order ordinary differential equations (ODEs) is given. A code written in the MACSYMA language is presented which finds and solves first-order DOEs invariant under group with infinitesimal generation of the form U = A(x)B(y)δ/sub x/ + C(x)D(y)δ/sub y/. An algorithm is given by which one can begin with an ODE y'= f(x,y) with known solution phi(x,y) = c and obtain a possibly larger class of ODEs with solutions given in closed form. A final algorithm for forming a sequence of solvable differential equations is suggested. The work can be generalized to higher-order differential equations, partial differential equations, and difference equations. 1 table.

44177 (LA-UR—79-982) **Sensitivity analysis.** McKay, M.D. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780691—2). Dep. NTIS, PC A02/MF A01.

From Workshop on validation of mathematical models; Dallas, TX, USA (21 Jun 1978).

General remarks on sensitivity analysis, the study of changes in a model output produced by varying model inputs, are made first. Sampling methods are discussed, and three sensitivity measures: partial rank correlation, derivative or response surface, and partial variance are described. Some sample results for a 16-input, 13-output hydrodynamics model are given. Both agreement and disagreement were found among the sensitivity measures. 4 figures. (RWR)

44178 (LA-UR—79-1086) **Computational problems related to a new probability distribution.** Beckman, R.J.; Johnson, M.E.; Tietjen, G.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-790544—1). Dep. NTIS, PC A02/MF A01.

From 12. symposium on the interface; Waterloo, Canada (10 May 1979).

Some computational problems related to a new probability distribution recently developed by the authors are described. This distribution can be viewed as a generalization of the exponential power distribution. The three topics discussed here are density and distribution function evaluation, moment matching, and random variate generation. 1 figure, 1 table.

44179 (LA-UR—79-1172) **Multiparameter data acquisition and display program.** Sunier, J.W.; Poore, R.V.; McMillan, D.E. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-790549—5). Dep. NTIS, PC A02/MF A01.

From Conference on computerized data - acquisition systems in particle and nuclear physics; Santa Fe, NM, USA (14 May 1979).

A general-purpose multiparameter data acquisition, histogramming, and display program is presented. The 32 input parameters of the program consist of up to 16 CAMAC words of 16 bits, and up to 16 algebraic functions of these words. Up to 64 one- and two-dimensional histograms based on these parameters can be constructed, subject to up to 144 correlated conditions imposed on the input parameters. The display system consists of a rapid refresh scope with 10-bit X and Y resolution and a push-botton panel, specifically designed to interact dynamically with either the display or the data acquisition programs. Typical event rates vary between 300 Hz and 10 kHz, depending on the number of histograms generated and on their filtering conditions. 1 figure.

44180 (LBL—8277) **Long term file migration. Part I: file reference patterns.** Smith, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 47p. Dep. NTIS, PC A03/MF A01.

In most large computer installations, files are moved between on-line disk and mass storage (tape, integrated mass storage device) either automatically by the system or specifically at the direction of the user. This is the first of two papers which study the selection of algorithms for the automatic migration of files between mass storage and disk. The use of the text editor data sets at the Stanford Linear Accelerator Center (SLAC) computer installation is examined through the analysis of thirteen months of file reference data. Most files are used very few times. Of those that are used sufficiently frequently that their reference patterns may be examined, about a third show declining rates of reference during their lifetime; of the remainder, very few (about 5%) show correlated interreference intervals, and interreference intervals (in days) appear to be more skewed than would occur with the Bernoulli process. Thus, about two-thirds of all sufficiently active files appear to be referenced as a renewal process with a skewed interreference distribution. A large number of other file reference statistics (file lifetimes, interference distributions, moments, means, number of uses/file, file sizes, file rates of reference, etc.) are computed and presented. The results are applied in the following paper to the development and comparative evaluation of file migration algorithms. 17 figures, 13 tables.

44181 (LBL—8722) **One shots and alternatives in synchronous digital system design.** Hui, S.; Meng, J.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1979. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

Undesirable features of nonostable multivibrators (one shots) in digital integrated circuits are described and some alternatives to their use are discussed. These include flip-flops and gates, delay lines, and other methods.

44182 (SAND—78-0135C) **What everyone solving differential equations numerically should know.** Shampine, L.F. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 22p. (CONF-781248—1). Dep. NTIS, PC A02/MF A01.

From Computational techniques for ordinary differential equations conference; Manchester, UK (18 Dec 1978).

The solution of the initial-value problem for a set of ordinary differential equations (ODEs) is probably the most complicated numerical task that people expect to solve with a black box code. Dramatic improvements in speed, reliability, and convenience have been made in the last 15 years to codes for the solution of ODEs. Even so, the state of the art requires that users of the codes be aware of potential difficulties. The codes do not even try to do what the layman expects. Furthermore, the computational problem is not the same as the mathematical problem-not understanding the distinction can seriously affect the results. It is not always possible to say what

should be done to achieve the desired accuracy. Not all codes are equally effective in their handling of the art of computation. As a consequence, users must be careful how they apply a given code and interpret its results. Specific examples are given for popular codes. (RWR)

44183 (SLAC-PUB—2302) **Simulation of LSI-11/PDP-11 series minicomputers.** Myers, J.R.; Cottrell, R.L.A.; Bricaud, B.M. (Stanford Linear Accelerator Center, CA (USA)). Apr 1979. Contract EY-76-C-03-0515. 6p. (CONF-790454—1). Dep. NTIS, PC A02/MF A01.

From DECUS spring mini/midi symposium; New Orleans, LA, USA (17 Apr 1979).

A functional simulation of te PDP-11 series minicomputers was implemented to run either interactively or as a batch job on an IBM 370 computer. The simulator operates in two modes, the supervisor mode and the run mode. In the supervisor mode, the simulator implements a command language, which allows users to examine and change the contents of memory or other addressable registers in the simulated machine. Optionally, an instruction trace may also be turned on or off. In the run mode, the simulation of the instruction set is tested by successfully running DEC's MAINDEC basic instruction test on the simulated machine. The interrupt structure is modeled. The simulation is open ended in the sense that users may define new peripheral devices, by including their own FORTRAN callable subroutines for each simulated device. Currently the following devices are supported: floppy disks, a console terminal, a card reader, a card punch, a line printer, and a communications multiplexer (DH11). With these devices DEC's RT-11 versions 2C and 3B have been successfully run on the simulator. At SLAC this simulator is proving useful in debugging software for one-of-a-kind hardware configurations, such as communications front end processors, that are not readily accessible for stand alone testing. 5 figures.

44184 (UCID—18075) **HEMPDS user's manual.** Warren, K.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Mar 1979. Contract W-7405-ENG-48. 61p. Dep. NTIS, PC A04/MF A01.

HEMPDS, the double-slide verson of two-dimensional HEMP, allows the intersection of slide lines and slide lines in any direction; thus, triangular zones can be utilized. This user's manual describes the input to HEMPDS, and also includes the equations used and sample problems. 16 figures, 5 tables.

44185 (UCRL—81922) **Scientific application coding in the context of dataflow.** Woodruff, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1978. Contract W-7405-ENG-48. 11p. (CONF-790614—1). Dep. NTIS, PC A02/MF A01.

From National computer conference 1979; New York, NY, USA (4 Jun 1979).

One potential use for dataflow computers is in scientific application computing: the numerical solution of partial differential equations. This article describes the type of computation that is carried out in support of applied physics research, with particular emphasis on the data dependencies that exist in both explicit and implicit finite difference equations. The features of these application codes that determine the scale of the computation to be performed are described, and present codes running on available computers are observed to be smaller scale solutions than ideal physical modelling would require. One possible avenue to significantly faster computation is the dataflow concept. Before programs can be written for a hypothetical dataflow computer, several programming techniques need to be developed. These techniques are embodied in the programming languages and the data types that are used to express a program. Imperative and applicative language styles are described and compared to the semantic basis of a dataflow computer. Data types that are used in conventional computer codes are examined, and certain shortcomings relative to dataflow computing are noted. The need exists for a data type that can make the data dependencies between elements of arraylike entities explicit.

44186 (UCRL—81931) **SLIC: an interactive mesh generator for finite element and finite difference application programs.** Gerhard, M.A.; Greenlaw, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 May 1979. Contract W-7405-ENG-48. 18p. (CONF-790802—15). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

Computers with extended memory, such as the CDC STAR 100 and the CRAY 1 with mega-word capacities, are greatly enlarging the size of finite element problems which can be solved. The cost of developing and testing large meshes can be prohibitive unless one uses a computer program for mesh generation and plotting. SLIC is an interactive mesh program which builds and plots 2- and 3-D continuum meshes from interactive terminal or disc input. The user inputs coordinates for certain key points and enters commands which complete the description of the geometry. Entire surfaces and volumes are then generated from the geometric skeleton. SLIC allows the user to correct input errors and saves the corrected command list for later reuse. The mesh can be plotted on a video display at any stage of development to evaluate the work in progress. Output is in the form of an input file to a user-selected computer code. Among the available output types are ADINA, SAP4, and NIKE2D. 11 figures.

44187 (UCRL—81974) **LIEPROC: a MACSYMA program for finding adiabatic invariants of simple Hamiltonian systems via the Lie transform.** Char, B.; McNamara, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Nov 1978. Contract W-7405-ENG-48. 38p. (CONF-790629—1). Dep. NTIS, PC A03/MF A01.

From 2. MACSYMA users conference; Washington, DC, USA (20 Jun 1979).

The usage and performance of a program in a symbolic manipulation language that computes adiabatic invariants of certain Hamiltonian systems via the Lie transform are discussed. 1 table.

44188 (UCRL—82513) **Archival storage requirements.** Michael, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Mar 1979. Contract W-7405-ENG-48. 7p. (CONF-790448—3). Dep. NTIS, PC A02/MF A01.

From SPIE; Washington, DC, USA (17 Apr 1979).

The Lawrence Livermore Laboratory has had a decade of experience with the use of an archival computer storage facility. A continuing need is seen for such capabilities at the Department of Energy laboratories. This need arises from the increased speeds of large computers and from their proliferation as well. Surveys of potential sources suggest that te soonest and likeliest possibilities for developing an archival storage system are offered by optical technologies. The requirements for such a facility are briefly discussed. 1 figure, 1 table.

44189 (UCRL—82619) **Future trends in data base software.** Jones, S.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 16p. (CONF-790431—2). Dep. NTIS, PC A02/MF A01.

From 20. AESOP conference; Gatlinburg, TN, USA (24 Apr 1979).

In the 1970's, the Data Base Management System (DBMS) became a major software component in most commercial computing facilities, and is now becoming more widely used in scientific computing. This paper assesses the trends in DBMS research to infer the type of software that will be available in coming years. The very exciting area of data management functions implemented in hardware is only mentioned briefly. The relational model is discussed because much of the current research is based on this model and its terminology. While the relational approach is not necessarily the wave of the future, its impact is being and will be felt.

44190 (JPRS—73207) **Translations on USSR science and technology: Physical Sciences and Technology, No. 64.** 11 Apr 1979. Translation of various articles. 70p. NTIS.

The report contains information on aeronautics; astronomy and astrophysics; atmospheric sciences; chemistry; earth sciences and oceanography; electronics and electrical engineering; energy conversion; materials; mathematical sciences; cybernetics, computers; mechanical, industrial, civil, and marine engineering; methods and equipment; missile technology; navigation, communications, detection, and countermeasures, nuclear science and technology; ordnance; physics; propulsion and fuels; space technology; and scientists and scientific organization in the physical sciences.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 43178, 44180

44191 (BETC/IC—79/1) **Bartlesville Energy Technology Center publications, January 19, 1975—September 30, 1977.** Mohr, E.B.;Gudgel, M.L. (comp.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Apr 1979. 81p. Dep. NTIS, PC A05/MF A01.

This bibliography of 164 entries contains abstracts of reports and articles published by Bartlesville Energy Technology Center (BETC) authors during the period of time the Center was part of the Energy Research and Development Administration (ERDA). BERC-numbered contract reports monitored by Center personnel are included under corporate authors.

44192 (BNL—26010) **Use of SYSTEM 2000 in a scientific research environment.** Benkovitz, C.M. (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract EY-76-C-02-0016. 26p. (CONF-790461—1). Dep. NTIS, PC A03/MF A01.

From Spring meeting of the association of SYSTEM 2000 Users for technical exchange (ASTUTE); Austin, TX, USA (3 Apr 1979).

The use of SYSTEM 2000 to help handle some of the scientific data needed by research programs with the Atmospheric Sciences Division of the Department of Energy and Environment at Brookhaven National Laboratory is discussed. The computing environment at the Central Scientific Computing Facility is briefly described, and similarities and differences with highly centralized corporate and administrative data environments are presented. Specific examples of SYSTEM 2000 scientific data bases in current use are described. Author experiences and conclusions in the use of this DBMS in a research environment are discussed, and future plans and alternatives are briefly presented. 6 figures, 4 tables.

44193 (CONF-790461—2) **World energy data system (WENDS).** Lareau, W.E. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 45p. Dep. NTIS, PC A03/MF A01.

From Spring meeting of the association of SYSTEM 2000 Users for technical exchange (ASTUTE); Austin, TX, USA (3 Apr 1979).

This paper presents a unique application of System 2000: the storage of preformatted textual information in a completely user oriented data base. The World Energy Data System is an information system which alloys qualified users online access to non-classified management level data on worldwide energy technology and research and development activities. WENDS has been used to transmit up-to-date informaion on foreign energy technology and research and development programs to DOE program divisions, the Congress, and other U.S. government officials going abroad. The WENDS concept is first described. Then, the method of storage of the textual information is discussed followed by a discussion of the retrieval system which is thoroughly designed to serve the user. (MCW)

44194 (DOE/TIC—4579-R10(Suppl.4)) **Energy information data base. Serial titles, February 1976—March 1979.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Mar 1979. 87p. Dep. NTIS, PC A05/MF A01.

This supplement contains changes and additions to TID-4579-R10 (Serial titles used by the DOE Technical Information Center) and is intended for use with that publication.

44195 (SAND—79-0858C) **Toward automating the database design process.** Asprey, P.L. (Sandia Labs., Albuquerque, NM (USA)). 25 Apr 1979. Contract AC04-76DP00789. 20p. (CONF-790431—3). Dep. NTIS, PC A02/MF A01.

From 20. AESOP conference; Gatlinburg, TN, USA (24 Apr 1979).

Portions of document are illegible.

One organization's approach to designing complex, interrelated databases is described. The problems encountered and the techniques developed are discussed. A set of software tools to aid the designer and to produce an initial database design directly is presented. 5 figures.

44196 (UCID—18094) **Production of a handbook: Nd-doped glass spectroscopic and physical properties.** Saroyan, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1979. Contract W-7405-ENG-48. 142p. Dep. NTIS, PC A07/MF A01.

The production of Lawrence Livermore Laboratory publication M-095, a handbook containing a collection of properties of Nd^{3+}-doped glasses, is described. The pros and cons of the method are presented. The bulk of the report is contained in detailed appendices which cover major aspects of production.

44197 **Psychology of the design of information systems.** Gingras, L. Los Angeles, CA; Univ. of California (1977). 186p. University Microfilms Order No. 77-23,862.

Thesis (Ph. D.).

The design of information systems demands a good knowledge of the characteristics of the user-manager and his decision-making process. However, designers are not generally provided with adequate techniques for the determination of the managers' psychological characteristics. Thus, designers frequently implicitly assume that users are psychologically similar to themselves. This study focused on differences in psychological characteristics of designers and users of information systems. A questionnaire was distributed to designers and users of a computer-based operations control information system. All the designers who were involved in the implementation of the system answered the questionnaire. Properly-filled-out questionnaires were received from fifty-two managers who had access to the system and could use it for their decision-making activities.

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In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

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Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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EX-76-C-01-2295-009	Massachusetts Inst. of Tech., Cambridge (USA)	
	4:42186	MIT—2295T9-9
EX-76-C-01-2295-027	Massachusetts Inst. of Tech., Cambridge (USA)	
	4:42211	FE-MIT—2295T27-6
EX-76-C-01-2337	RAND Corp., Santa Monica, CA (USA)	
	4:43194	RAND/R—2335-DOE
	4:43222	RAND/R—2257-DOE
EX-76-C-01-2346	Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.	
	4:42343	FE—2346-38
EX-76-C-01-2356	Fairchild Industries, Inc., Manhattan Beach, CA (USA). Fairchild Stratos Div.	
	4:42165	FE—2356-88
EX-76-C-01-2445	Water Purification Associates, Cambridge, MA (USA)	
	4:42232	FE—2445-1(Vol.1)
EX-76-C-01-2452	Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.	
	4:43634	FE—2452-15
EX-76-C-01-2489	Institute of Gas Technology, Chicago, IL (USA)	
	4:42267	FE—2489-31
EX-76-C-01-2495	Dalton-Dalton-Little-Newport, Cleveland, OH (USA)	
	4:42233	FE—2495-T13
EX-76-S-01-2537	Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry	
	4:42218	FE—2537-8
EY-76-A-08-0474	Geological Survey, Denver, CO (USA)	
	4:43819	USGS—474-261
	4:43858	USGS—474-262
EY-76-C-02-0016	Brookhaven National Lab., Upton, NY (USA)	
	4:42480	BNL—26130
	4:42497	BNL—26047
	4:42560	BNL—25935
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	4:42770	BNL—25909
	4:42888	BNL-NUREG—24837
	4:42901	BNL-NUREG—25715
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	4:42965	BNL—25641
	4:43174	BNL—26045
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	4:43469	BNL-NUREG—25735
	4:43476	BNL—26099
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	4:43681	BNL—50980
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	4:43790	BNL—25997
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EY-76-C-02-0069	Chicago Univ., IL (USA). Dept. of Radiology	
	4:43687	CONF-780783—1
EY-76-C-02-1198	Illinois Univ., Urbana (USA)	
	4:43481	COO—1198-1258
	4:43535	COO—1198-1249
EY-76-C-02-2114	Colorado Univ., Boulder (USA)	
	4:43692	COO—2114-30
EY-76-C-02-2426-005	Combustion Engineering, Inc., Windsor, CT (USA)	
	4:42889	CEND—376
EY-76-C-02-2477	United Engineers and Constructors, Inc., Philadelphia, PA (USA)	
	4:42848	NUREG—0246
EY-76-C-02-2708-003	National Academy of Sciences - National Research Council, Washington, DC (USA)	
	4:43860	COO—2708T003-2
	4:43861	COO—2708T003-3
EY-76-C-02-2708-017	National Academy of Sciences, Washington, DC (USA)	
	4:43580	COO—2708T017-1
EY-76-C-02-2764	Mechanical Technology, Inc., Latham, NY (USA)	
	4:42484	COO—2764-002
EY-76-C-02-2857	Public Service Electric and Gas Co., Newark, NJ (USA)	
	4:43171	EPRI-EM—1005
EY-76-C-02-3045-029	Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.	
	4:43034	WARD-SR—3045-8
	4:43035	WARD-SR—3045-9
EY-76-C-02-3071	Fermi National Accelerator Lab., Batavia, IL (USA)	
	4:43670	COO—3071-239
	4:43947	COO—3071-238
EY-76-C-02-3073	Princeton Univ., NJ (USA). Plasma Physics Lab.	
	4:44069	PPPL—1545
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EY-76-C-02-3490	Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics	
	4:43801	UR—3490-1549(Vols.1-2)
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	4:43769	COO—3531-36
EY-76-C-02-4033	General Electric Co., Houston, TX (USA). Space Div.	
	4:42281	BETC—4033-3
EY-76-C-02-4049	Management and Technical Services Co., Philadelphia, PA (USA)	
	4:43258	COO—4049-1
EY-76-C-02-4094	Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.	
	4:42563	COO—4094-31
EY-76-C-03-0010-021	California Univ., Los Angeles (USA). Dept. of Electrical Sciences and Engineering	
	4:44105	UCLA-ENG—7931
EY-76-C-03-0012	California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology	
	4:43800	UCLA—12-1167
	4:43809	UCLA—12-1176
EY-76-C-03-0115-099	SRI International, Menlo Park, CA (USA)	
	4:42375	SAN—0115/99-1
EY-76-C-03-0167-023	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-038	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-065	**General Atomic Co., San Diego, CA (USA)**	
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EY-76-C-03-0515	**Stanford Linear Accelerator Center, CA (USA)**	
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	4:44183	SLAC-PUB—2302
EY-76-C-03-0700	**Energy Technology Engineering Center, Canoga Park, CA (USA)**	
	4:42652	CONF-780550—9
EY-76-C-03-0893-027	**General Electric Co., San Jose, CA (USA). Nuclear Energy Div.**	
	4:42921	NEDO—12668
EY-76-C-03-0893-031	**General Electric Co., Sunnyvale, CA (USA)**	
	4:42917	GEFR-SP—149
EY-76-C-03-1282	**Westinghouse Electric Corp., Pittsburgh, PA (USA)**	
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EY-76-C-03-1286	**RCA Labs., Princeton, NJ (USA)**	
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EY-76-C-04-0053	**Mound Facility, Miamisburg, OH (USA)**	
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EY-76-C-04-0487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
	4:43708	MHSMP—79-7
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	4:43381	BDX—613-2160(Rev.)
	4:43628	BDX—613-2138(Rev.)
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EY-76-C-04-0656	**General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.**	
	4:44175	GEPP—342
EY-76-C-04-0789	**Sandia Labs., Albuquerque, NM (USA)**	
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	4:42206	SAND—79-0085
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EY-76-C-04-3533	**SEE ALSO- 9509480 Atomics International Div., Golden, CO (USA). Rocky Flats Plant**	
	4:42409	RFP—2812
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EY-76-C-05-0033	**Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis**	
	4:43732	ORAU/IEA—79-6(0)
EY-76-C-05-3688	**Department of Energy, Washington, DC (USA). Office of Health and Environmental Research**	
	4:43718	CONF-7808100—(Summ)
EY-76-C-05-5205	**Battelle Columbus Labs., OH (USA)**	
	4:42325	FE—5205-T1
	4:42326	ORO—5205-T2
EY-76-C-06-1030	**SEE ALSO- 9509481 Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations**	
	4:42425	RHO-ST—1
EY-76-C-06-1388	**Washington Univ., Seattle (USA). Nuclear Physics Lab.**	
	4:43984	DOE/ER—01388-345
EY-76-C-06-1830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
	4:42345	PNL—2596
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EY-76-C-06-1857	**United Nuclear Industries, Inc., Richland, WA (USA)**	
	4:42987	UNI-SA—57
EY-76-C-07-1540	**Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office**	
	4:42404	ICP—1179
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EY-76-C-07-1546	**Terra Tek, Inc., Salt Lake City, UT (USA)**	
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EY-76-C-07-1570	**Los Alamos Scientific Lab., NM (USA)**	
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EY-76-C-08-0410	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)**	
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EY-76-C-08-0623	**CER Geonuclear Corp., Grand Junction, CO (USA)**	
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EY-76-C-08-0680	**Pacific Transmission Supply Co., Casper, WY (USA)**	
	4:42334	NVO—6080-1
EY-76-C-08-0703	**Hawaii Univ., Honolulu (USA). Office of Research Administration**	
	4:43779	NVO—0703-2
EY-76-C-08-1183	**EG and G, Inc., Las Vegas, NV (USA)**	
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EY-76-C-09-0001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	4:42350	DP-MS—79-1
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EY-76-C-11-0014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
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EY-76-C-12-0052	**Knolls Atomic Power Lab., Schenectady, NY (USA)**	
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EY-76-C-13-1664	**Science Applications, Inc., La Jolla, CA (USA)**	
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EY-76-C-21-8002	**Pennzoil Co., Bradford, PA (USA)**	
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EY-76-S-02-0063	**Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry**	
	4:42214	COO—0063-10
EY-76-S-02-1599	**Michigan State Univ., Hickory Corners (USA). W.K. Kellogg Biological Station**	
	4:43781	COO—1599-139(Pt.1)
EY-76-S-02-1617	**Nebraska Univ., Lincoln (USA). Dept. of Chemistry**	
	4:43573	COO—1617-58
EY-76-S-02-2218	**Illinois Univ., Urbana (USA). Fusion Studies Lab.**	
	4:44077	COO—2218-125
EY-76-S-02-2245	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering**	
	4:42912	COO—2245-27TR(Rev.1)
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EY-76-S-02-2542	**Princeton Univ., NJ (USA). Dept. of Chemistry**	
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EY-76-S-02-2753	**Kansas State Univ., Manhattan (USA)**	
	4:43923	COO—2753-104
EY-76-S-02-2874	**Stanford Univ., CA (USA). Dept. of Statistics**	
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EY-76-S-02-2927	**Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering**	
	4:43260	COO—2927-1
EY-76-S-02-2989	**Cincinnati Univ., OH (USA). Dept. of Biological Sciences**	
	4:42307	COO—2989-T1
EY-76-S-02-3158	**Cornell Univ., Ithaca, NY (USA)**	
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	4:43707	COO—3158-64
EY-76-S-02-3173	**Cornell Univ., New York (USA). Dept. of Medicine**	
	4:43823	COO—3173-18
EY-76-S-02-3278	**Energy Research and Development Administration, Washington, DC (USA). Div. of Biomedical and Environmental Research**	
	4:43777	COO—3278-T1
EY-76-S-02-3474	**State Univ. of New York, Syracuse (USA). Coll. of Environmental Science and Forestry**	
	4:43845	COO—3474-4
EY-76-S-02-3533	**Syracuse Univ., NY (USA). Dept. of Physics**	
	4:43961	COO—3533-136
EY-76-S-02-4064	**Adelphi Research Center, Inc., Garden City, NY (USA)**	
	4:43954	COO—4064-1
EY-76-S-02-4119	**Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.**	
	4:42942	MIT-EL—78-009
EY-76-S-03-0034-269	**California Univ., Berkeley (USA). Coll. of Engineering**	
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EY-76-S-05-4398	**Florida Univ., Gainesville (USA)**	
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EY-76-S-05-4918	**Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science**	
	4:42666	ORO—4918-11
EY-76-S-05-4936	**Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy**	
	4:44015	ORO—4936-4
EY-76-S-05-5246	**Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station**	
	4:43385	ORO—5246-3

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	4:42238	RLO—2229/T15-3
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EY-77-C-06-1030	**Woodward-Clyde Consultants, San Francisco, CA (USA)**	
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EY-77-C-21-2936	**Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Research Center**	
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EY-77-S-02-4560	**Utah Univ., Salt Lake City (USA)**	
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EY-77-S-02-4589	**Marquette Univ., Milwaukee, WI (USA)**	
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EY-77-S-09-0980	**Oregon State Univ., Corvallis (USA). Dept. of Air Resources**	
	4:43739	SR—0980-6
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EY-77-X-06-0626	**Nor'West-Pacific Corp., Seattle, WA (USA)**	
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666	4:44059	Dep. NTIS (US Sales Only), PC A02/MF A01
BNWL-tr-		
329	4:42986	Dep. NTIS, PC A03/MF A01
CAAP-TR-		
050	4:42878	Dep. NTIS, PC A07/MF A01
CDAP-TR-		
051	4:42988	Dep. NTIS, PC A15/MF A01
054	4:42989	Dep. NTIS, PC A05/MF A01
055	4:42879	PC E02/MF E02
CEND-		
376	4:42889	Dep. NTIS, PC A08/MF A01
CONF-750820-	(Conference on photoionization and other probes of many-electron interactions, Carry-le-Rouet, France, 31 Aug-13 Sep 1975)	
	4:43928	New York, NY; Plenum Press (1976).
CONF-760175-	(Trends and opportunities in seismology workshop, Pacific Grove, CA, USA, 3-9 Jan 1976)	
	4:43861	*See* COO-2708T003-3
CONF-7611105-	(APCA specialty conference on toxic substances in the air environment, Cambridge, MA, USA, 7-9 Nov 1976)	
	4:43768	Pittsburgh, PA; Air Pollution Control Association (1977).
CONF-7704111-	(52. annual meeting of the WV academy of science, Salem, WV, USA, 1-2 Apr 1977)	
1	4:42228	Morgantown, WV; West Virginia University (1977).
CONF-770505-	(International conference on nuclear power and its fuel cycles, Salzburg, Austria, 2-13 May 1977)	
350(Trans)	4:42370	*See* MLM-2599(TR)
CONF-770524-	(ASTM symposium on fatigue testing of weldments, Toronto, Canada, May 1977)	
4	4:42921	*See* NEDO-12668
CONF-770709-	(10. international conference on high energy accelerators, Serpukhov, USSR, 11-17 Jul 1977)	
24(trans)	4:43686	*See* UCRL-Trans-1555
CONF-770942-	(SPIE/SPSE conference on application of optical instrumentation in medicine, Boston, MA, USA, 25-27 Sep 1977)	
2	4:43814	Dep. NTIS, PC A02/MF A01
CONF-7709158-	(2. conference of the New England Solar Energy Association, Hartford, CT, USA, 8-11 Sep 1977)	
	4:42537	Brattleboro, VT; New England Solar Energy Association (1977).
CONF-771082-	(105. American Public Health Association, Washington, DC, USA, 30 Oct-3 Nov 1977)	
2	4:43790	*See* BNL-25997
CONF-7710159-	(DKV annual meeting, Hannover, F.R. Germany, 6-7 Oct 1977)	
4	4:43285	*See* AED-CONF-77-405-007
CONF-7710181-	(3. test methodology information exchange program conference, Kansas City, MO, USA, 11-12 Oct 1977)	
1	4:44175	*See* GEPP-342
CONF-7710194-	(Tire rolling losses and fuel economy a R and D planning workshop, Cambridge, MA, USA, 18-20 Oct 1977)	
	4:43294	Troy, MI; Society of Automotive Engineers, Inc. (1977).
CONF-771158-	(Seminar on microbial conversion systems for food and fodder production and water management, Kuwait City, Kuwait, 12-17 Nov 1977)	
2	4:42637	Miami, FL; University of Miami (1977).
CONF-7711102-	(Conference on possibilities of designing coal energy production facilities not harmful to the environment and gas purification in connection with thermal power stations, Essen, F.R. Germany, 17-18 Nov 1977)	
3	4:42851	*See* AED-CONF-77-564-001
CONF-771271-	(Congress on the development of energy demand and possibilities of supply, Berlin, F.R. Germany, 5-7 Dec 1977)	
2	4:43219	*See* AED-Conf-77-544-002
CONF-780223-	(84. AIChE national meeting, Atlanta, GA, USA, 24 Feb-1 Mar 1978)	
6	4:42517	Merriam, KS; Gulf Oil Chemical Co. (1978).
CONF-780305-	(American Chemical Society conference, Anaheim, CA, USA, 12-17 Mar 1978)	
P5	4:42208	23: No. 2, 76-78(1978)
P5	4:42220	University Microfilms, Ann Arbor, MI, $8.00
P5	4:42346	23: No. 2, 125-133(1978)
CONF-780357-	(National conference of the American Wind Energy Association, Amarillo, TX, USA, 1-5 Mar 1978)	
	4:42824	$9.00
CONF-7803100-	(Meeting on models and techniques to secure decisions, Essen, F.R. Germany, 2-3 Mar 1978)	
1	4:42242	*See* AED-Conf-78-178-005
CONF-780453-	(Neutrinos, West Lafayette, IN, USA, 28 Apr-2 May 1978)	
13	4:43947	*See* COO-3071-238
CONF-7804102-	(Systems exhibition energy within the context of the Hannover fair, Hannover, F.R. Germany, 19-27 Apr 1978)	
35	4:42841	*See* AED-CONF-78-155-060
CONF-780507-	(Probabilistic analysis of nuclear reactor safety, Los Angeles, CA, USA, 8-10 May 1978)	
P1	4:43044	$42.00 (3 Vol. set)
P2	4:43056	$42.00 (3 Vol. set)
P3	4:43093	$42.00 (3 Vol. set)
CONF-780550-	(Seminar on testing solar energy materials and systems, Washington, DC, USA, 22-24 May 1978)	
9	4:42652	Dep. NTIS, PC A02/MF A01
CONF-780582-	(International conference on the economic use of electric road vehicles in a changing environment, Sheffield, UK, 23-24 May 1978)	
	4:43363	Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096
CONF-7805110-	(Working group on irradiation devices, Petten, Netherlands, 18-19 May 1978)	
2	4:42986	*See* BNWL-tr-329

Report No.	Abstract No.	Availability
CONF-7805128-		(Symposium on cytogenetics studies and risk assessment for chemical mutagens and ionizing radiation, Spring Harbor, NY, USA, 14-17 May 1978)
1	4:43821	Dep. NTIS, PC A03/MF A01
2	4:43822	*See* BNL-25840
CONF-7805149-		(IMS special topics meeting on time series analysis, Ames, IA, USA, 1-3 May 1978)
2	4:44174	Dep. NTIS, PC A03/MF A01
CONF-7805177-		(Systems theory in immunology conference, Rome, Italy, 29-31 May 1978)
1	4:43805	*See* LA-UR-79-1069
CONF-780619-		(IEEE photovoltaic specialists conference, Washington, DC, USA, 5-8 Jun 1978)
	4:42587	New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1978).
CONF-780622-		(ANS annual meeting, San Diego, CA, USA, 18-23 Jun 1978)
80	4:42412	*See* RHO-SA-23
CONF-780691-		(Workshop on validation of mathematical models, Dallas, TX, USA, 21-23 Jun 1978)
2	4:44177	*See* LA-UR-79-982
CONF-7806114-		(Faculty Institute, Inertial Confinement Fusion, Argonne, IL, USA, 5-9 Jun 1978)
2	4:44146	*See* UCRL-82026
CONF-780748-		(Hydrogen for energy distribution, Chicago, IL, USA, 24-28 Jul 1978)
	4:42489	$60.00
CONF-780783-		(20. American Association of Physicists in Medicine annual meeting, San Francisco, CA, USA, 30 Jul-3 Aug 1978)
1	4:43687	Dep. NTIS, PC A02/MF A01
CONF-780788-		(9. international symposium on high energy multiparticle dynamics, Tabor, Czechoslovakia, 2-7 Jul 1978)
5	4:43969	*See* FERMILAB-CONF-78/75-THY
CONF-780791-		(ISABELLE summer workshop, Upton, NY, USA, 17-28 Jul 1978)
1	4:43661	*See* BNL-25896
CONF-780806-		(17. symposium on combustion, Leeds, UK, 20-25 Aug 1978)
4	4:43581	*See* KWIS-22/1978
CONF-780826-		(19. conference on high energy physics, Tokyo, Japan, 23-31 Aug 1978)
31	4:43952	*See* BNL-25057
CONF-780899-		(Conference on radiation safety in NDT, San Francisco, CA, USA, 1-3 Aug 1978)
1	4:43824	*See* HEDL-SA-1502FP
CONF-7808100-		(Forest meteorology-research needs for an energy and resource limited future, Ottawa, Canada, 28-30 Aug 1978)
(Summ)	4:43718	Dep. NTIS, PC A03/MF A01
CONF-7808102-		(Engineering Foundation conference - waste heat utilization, Henniker, NH, USA, 13-18 Aug 1978)
	4:43326	Dep. NTIS, PC A15/MF A01
CONF-7808106-		(International conference on lasers 1978, San Diego, CA, USA, 20-25 Aug 1978)
1	4:43610	*See* UCRL-81940
CONF-7808107-		(1978 DUMAD summer workshop, San Diego, CA, USA, 11 Aug 1978)
1	4:43875	*See* UCRL-82152
CONF-780952-		(Applied superconductivity conference, Pittsburgh, PA, USA, 25-28 Sep 1978)
46	4:43259	Dep. NTIS, PC A03/MF A01
CONF-7809140-		(Western coal-problems, progress, and promises, Keystone, CO, USA, 10-15 Sep 1978)
(Summ.)	4:42269	$7.00
CONF-781007-		(IAEA symposium on nuclear material safeguards, Vienna, Austria, 2-6 Oct 1978)
19	4:42442	*See* AECL-6347
CONF-781022-		(Meeting on nuclear power reactor safety, Brussels, Belgium, 16-19 Oct 1978)
43	4:43002	*See* GA-A-15110
CONF-781033-		(IEEE nuclear science symposium, Washington, DC, USA, 18-20 Oct 1978)
38	4:43700	*See* LBL-7590
41	4:43697	*See* LBL-8307
43	4:43693	*See* LBL-8136
45	4:43670	*See* COO-3071-239
CONF-781046-		(1. information exchange conference, Luray, VA, USA, 24-26 Oct 1978)
	4:43146	Dep. NTIS, PC A19/MF A01
CONF-781053-		(APS plasma physics meeting, Colorado Springs, CO, USA, 30 Oct-3 Nov 1978)
13	4:44144	*See* UCRL-81327
CONF-781072-		(Coal technology conference, Houston, TX, USA, 17 Oct 1978)
P1	4:42151	ICUC, 6606 Bellaire Blvd., Suite 101, Houston, TX
P2	4:42253	ICUC, 6606 Bellaire Blvd., Suite 101, Houston, TX
CONF-7810120-		(PMI seminar/symposium, Anaheim, CA, USA, 7-11 Oct 1978)
1	4:42973	*See* HEDL-SA-1630
CONF-7810148-		(Seminar and status report on wind energy, Julich, F.R. Germany, 23-24 Oct 1978)
1	4:42822	*See* INKA-CONF-78-012-001
CONF-7810160-		(Conference on the outlook for natural gas, Washington, DC, USA, 30-31 Oct 1978)
1	4:42514	Chicago, IL; Inst. of Gas Tech. (1978).
CONF-7810161-		(Conference on documentation and analysis of improvements in efficiency and performance of HVAC equipment and systems, West Lafayette, IN, USA, 23-25 Oct 1978)
1	4:43276	Chicago, IL; Inst. of Gas Tech. (1978).
CONF-7810168-		(Association of records managers and administrators annual conference, Washington, DC, USA, 8 Oct 1978)
1	4:42972	*See* HEDL-SA-1537-FP
CONF-7810172-		(1978 international conference on the application of charge coupled devices, San Diego, CA, USA, 25-27 Oct 1978)
1	4:44072	*See* UCRL-81725
CONF-7810178-		(FCP research review conference, College Park, MD, USA, 3-6 Oct 1978)
1	4:43480	*See* BNL-25396
CONF-7810179-		(12. annual conference of the German-Swiss Fachverband fur Strahlenschultz, Norderney, F.R. Germany, 2-6 Oct 1978)
1	4:43775	*See* UCRL-81640
CONF-781105-		(ANS meeting, Washington, DC, USA, 12-17 Nov 1978)
95	4:43003	*See* HEDL-SA-1595-FP
P1	4:42883	*See* ORNL/RSIC-43
CONF-781109-		(Environmental control symposium, Washington, DC, USA, 28-30 Nov 1978)
29	4:42665	*See* LBL-8967
CONF-781113-		(5. conference on application of small accelerators, Denton, TX, USA, 6-8 Nov 1978)
36	4:43923	*See* COO-2753-104
CONF-781121-		(Annual meeting of Materials Research Society, Boston, MA, USA, 28 Nov-1 Dec 1978)
25	4:42413	*See* RHO-SA-54
CONF-781144-		(2. US-Japan seminar on HTGR safety technology, Fuji, Japan, 24-25 Nov 1978)
18	4:43004	*See* HEDL-SA-1688
CONF-781146-		(6. water reactor safety research meeting, Germantown, MD, USA, 6-9 Nov 1978)
14	4:42990	Dep. NTIS, PC A02/MF A01
CONF-781184-		(Workshop on the AGS fixed target research program, Upton, NY, USA, 8-9 Nov 1978)
6	4:43657	*See* BNL-25509
CONF-781192-		(HVDC power transmission conference, Portland, OR, USA, 28-30 Nov 1978)
	4:42861	Dep. NTIS, PC A14/MF A01
CONF-7811109-		(1978 winter meeting of American Nuclear Society, Washington, DC, USA, 12-16 Nov 1978)
P1	4:42883	*See* ORNL/RSIC-43
CONF-781247-		(2. international conference on energy storage, compression and switching, Venice, Italy, 5-8 Dec 1978)
1	4:44130	*See* LA-UR-79-1064
2	4:43582	*See* LA-UR-79-1202
3	4:44081	*See* UCRL-81962
CONF-781248-		(Computational techniques for ordinary differential equations conference, Manchester, UK, 18-20 Dec 1978)
1	4:44182	*See* SAND-78-0135C

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CONF-790101-		(4. symposium on turbulence, diffusion and air pollution, Reno, NV, USA, 15-18 Jan 1979)
3	4:43755	Dep. NTIS, PC A02/MF A01
CONF-790103-		(Plating in electronics industry symposium, San Francisco, CA, USA, 16-17 Jan 1979)
1	4:43706	*See* BDX-613-2128
CONF-790120-		(2. annual conference on absorber surfaces for solar receivers, Boulder, CO, USA, 24-25 Jan 1979)
3	4:42742	*See* SAND-78-2423C
CONF-790125-		(1. topical meeting on fusion reactor materials, Miami Beach, FL, USA, 29-31 Jan 1979)
48	4:44166	*See* LBL-8643
50	4:43424	Dep. NTIS, PC A02/MF A01
51	4:43425	Dep. NTIS, PC A02/MF A01
52	4:43426	Dep. NTIS, PC A03/MF A01
53	4:43427	Dep. NTIS, PC A02/MF A01
55	4:44165	*See* GA-A-15356
56	4:44153	*See* BNL-25812
62	4:44152	*See* BNL-25792
63	4:44154	Dep. NTIS, PC A02/MF A01
65	4:44164	*See* GA-A-15276
66	4:44155	Dep. NTIS, PC A02/MF A01
67	4:44156	Dep. NTIS, PC A02/MF A01
68	4:44157	Dep. NTIS, PC A02/MF A01
69	4:44158	Dep. NTIS, PC A02/MF A01
CONF-790147-		(Society of photo-optical instrumentation engineers, instrumentation in Astronomy III symposium, Tucson, AZ, USA, 29 Jan-1 Feb 1979)
1	4:43701	*See* LBL-8738
CONF-790153-		(Annual meeting of the APS, New York, NY, USA, 29 Jan-1 Feb 1979)
1	4:44145	*See* UCRL-81826
CONF-790213-		(6. energy technology conference and exposition, Washington, DC, USA, 26-28 Feb 1979)
6	4:42821	*See* DOE/NASA/1004-79/1
CONF-790216-		(1979 SAE Congress and Exposition Engine Modeling Session, Detroit, MI, USA, 26 Feb-2 Mar 1979)
4	4:43643	*See* DOE/NASA/1040-78/30
CONF-790219-		(AIME annual meeting, New Orleans, LA, USA, 18-21 Feb 1979)
6	4:42804	Dep. NTIS, PC A03/MF A01
8	4:42957	*See* HEDL-SA-1746-FP
9	4:42424	*See* RHO-SA-26
CONF-790229-		(32. annual symposium on fundamental cancer research, Houston, TX, USA, 27 Feb-2 Mar 1979)
2	4:43820	Dep. NTIS, PC A04/MF A01
CONF-790301-		(Hydrogen in metals international meeting, Munster, F.R. Germany, 6-9 Mar 1979)
10	4:42497	*See* BNL-26047
11	4:43448	Dep. NTIS, PC A03/MF A01
CONF-790305-		(ASME gas turbine closed-cycle session, San Diego, CA, USA, 11-15 Mar 1979)
6	4:42563	*See* COO-4094-31
CONF-790306-		(International conference on fast breeder reactor performance, Monterey, CA, USA, 5-8 Mar 1979)
14	4:42915	*See* GA-A-15175(Rev.)
16	4:42908	Dep. NTIS, PC A02/MF A01
CONF-790311-		(2. international conference on comp. meth. in nonlinear mech., Austin, TX, USA, 26-28 Mar 1979)
4	4:43617	*See* DP-MS-78-83
CONF-790320-		(Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks, Paris, France, 19-21 Mar 1979)
3	4:43857	*See* UCRL-82609
CONF-790321-		(2. international symposium on radiopharmaceuticals, Seattle, WA, USA, 18-23 Mar 1979)
6	4:43808	*See* BNL-25819
7	4:43795	*See* BNL-25851
CONF-790323-		(Symposium on high spin phenomena in nuclei, Argonne, IL, USA, 15-17 Mar 1979)
5	4:44016	*See* BNL-26098
CONF-790327-		(IEEE particle accelerator conference, San Francisco, CA, USA, 12-14 Mar 1979)
52	4:43656	*See* LA-UR-79-706
97	4:43662	Dep. NTIS, PC A02/MF A01
108	4:43654	*See* LBL-8859
109	4:43653	*See* LBL-8810
112	4:43685	*See* SLAC-PUB-2284
121	4:43674	*See* SLAC-PUB-2268
126	4:43663	Dep. NTIS, PC A02/MF A01
127	4:43664	Dep. NTIS, PC A02/MF A01
128	4:43665	Dep. NTIS, PC A02/MF A01
130	4:43666	Dep. NTIS, PC A02/MF A01
132	4:43667	Dep. NTIS, PC A02/MF A01
133	4:43668	Dep. NTIS, PC A02/MF A01
134	4:43669	Dep. NTIS, PC A02/MF A01
135	4:43646	Dep. NTIS, PC A02/MF A01
136	4:43658	*See* BNL-25775
137	4:43680	*See* BNL-25777
138	4:43659	*See* BNL-25776
139	4:43660	*See* BNL-25779
140	4:43677	*See* TRI-PP-79-4
141	4:43650	*See* TRI-PP-79-6
142	4:43678	*See* TRI-PP-79-5
143	4:43651	*See* TRI-PP-79-7
144	4:43672	*See* LBL-8414
145	4:43675	*See* SLAC-PUB-2290
146	4:43682	*See* LBL-8340
147	4:43684	*See* LBL-8412
148	4:43683	*See* LBL-8397
CONF-790328-		(Solar energy storage options workshop, San Antonio, TX, USA, 18-20 Mar 1979)
4	4:42770	*See* BNL-25909
6	4:43270	*See* BNL-25832
CONF-790337-		(New fuels and advances in combustion technologies symposium, New Orleans, LA, USA, 26-30 Mar 1979)
1	4:42501	Chicago, IL; Institute of Gas Technology (1979).
CONF-790341-		(International conference on modulated structures, Kailua-Kona, HI, USA, 22-25 Mar 1979)
5	4:43440	Dep. NTIS, PC A02/MF A01
7	4:43462	Dep. NTIS, PC A02/MF A01
CONF-790347-		(2. international conference on meson-nuclear physics, Houston, TX, USA, 5-9 Mar 1979)
9	4:43676	*See* TRI-PP-79-3
CONF-790348-		(Conference on the p,n reaction and the nucleon-nucleon force, Telluride, CO, USA, 29-31 Mar 1979)
2	4:44040	*See* UCRL-82665
3	4:44037	*See* IS-M-201
4	4:44041	Dep. NTIS, PC A02/MF A01
CONF-790349-		(DNA misers bluff symposium, Albuquerque, NM, USA, 27-29 Mar 1979)
1	4:43850	*See* SAND-79-0465C
CONF-790358-		(Association of energy engineers conference, San Francisco, CA, USA, 21-23 Mar 1979)
1	4:42809	*See* LBL-8918
CONF-790359-		(Conference on information sciences and systems, Baltimore, MD, USA, 28-30 Mar 1979)
1	4:44171	*See* BNL-25939
CONF-790362-		(Heat pump technology information exchange meeting, Gaithersburg, MD, USA, 7 Mar 1979)
1	4:43263	Dep. NTIS, PC A02/MF A01
CONF-790364-		(Nonradial and nonlinear stellar pulsation workshop, Tucson, AZ, USA, 12-16 Mar 1979)
1	4:43871	*See* LA-UR-79-921
3	4:43872	*See* LA-UR-79-922
CONF-790365-		(16. rencontre de moriond, Les Arcs, Savoie, France, 17-23 Mar 1979)
1	4:43953	*See* BNL-26056
CONF-790366-		(National American Society for Nondestructive Testing spring conference, San Diego, CA, USA, 2 Mar 1979)
1	4:43624	*See* HEDL-SA-1705
CONF-790367-		(8. national conference and exhibition on municipal sludge management, Miami Beach, FL, USA, 19-21 Mar 1979)
1	4:43338	*See* SAND-79-7034C
CONF-790402-		(Computational methods in nuclear engineering, Williamsburg, VA, USA, 23-25 Apr 1979)
16	4:42909	Dep. NTIS, PC A02/MF A01
CONF-790405-		(AICE meeting, Houston, TX, USA, 1-5 Apr 1979)
17	4:42210	Dep. NTIS, PC A03/MF A01

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CONF-790408-		(3. ASCE specialty conference on the structural design of nuclear plant facilities, Boston, MA, USA, 2-3 Apr 1979)
4	4:43033	*See* UCRL-81884
CONF-790415-		(177. ACS national meeting, Honolulu, HI, USA, 1-6 Apr 1979)
32	4:42810	*See* LBL-8973
33	4:43513	*See* UCRL-81374
34	4:43510	Dep. NTIS, PC A02/MF A01
35	4:42379	Dep. NTIS, PC A02/MF A01
CONF-790418-		(Scanning electron microscopy conference, Washington, DC, USA, 16-20 Apr 1979)
5	4:43847	*See* UR-3490-1539
CONF-790423-		(2. multiphase flow and heat transfer symposium workshop, Miami Beach, FL, USA, 16-18 Apr 1979)
9	4:42968	Dep. NTIS, PC A02/MF A01
11	4:42991	Dep. NTIS, PC A02/MF A01
12	4:42969	Dep. NTIS, PC A02/MF A01
13	4:42992	Dep. NTIS, PC A02/MF A01
CONF-790430-		(1. annual symposium on safeguards and nuclear material management, Brussels, Belgium, 25-27 Apr 1979)
5	4:42447	*See* LA-UR-79-1021
5	4:42471	*See* UCRL-82210
7	4:42448	*See* LA-UR-79-1029
8	4:42449	*See* LA-UR-79-1037
9	4:42450	*See* LA-UR-79-1038
10	4:42451	*See* MLM-2610(OP)
14	4:42464	*See* SAND-79-0059C
CONF-790431-		(20. AESOP conference, Gatlinburg, TN, USA, 24 Apr 1979)
2	4:44189	*See* UCRL-82619
3	4:44195	*See* SAND-79-0858C
CONF-790434-		(Spring meeting on western states section, and the Combustion Institute, Provo, UT, USA, 23-24 Apr 1979)
3	4:42190	*See* UCRL-82602
CONF-790437-		(5. international conference on positron annihilation, Lake Yamanaka, Japan, 8-11 Apr 1979)
4	4:43918	Dep. NTIS, PC A02/MF A01
5	4:43917	*See* BNL-26084
6	4:43391	Dep. NTIS, PC A02/MF A01
8	4:43900	Dep. NTIS, PC A02/MF A01
9	4:43382	Dep. NTIS, PC A02/MF A01
CONF-790439-		(Symposium on biophysics and physiology of carbon dioxide, Regensburg, F.R. Germany, 17-20 Apr 1979)
1	4:43537	*See* UCRL-82332
CONF-790441-		(ANS topical meeting on light water reactor fuel performance, Portland, OR, USA, 29 Apr-2 May 1979)
6	4:42993	Dep. NTIS, PC A02/MF A01
CONF-790442-		(International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Apr 1979)
7	4:44167	*See* SAND-78-2101C
10	4:44168	*See* SAND-78-2135C
11	4:44124	*See* SAND-78-2128C
CONF-790443-		(American power conference, Chicago, IL, USA, 23-25 Apr 1979)
1	4:42987	*See* UNI-SA-57
CONF-790444-		(Offshore technology conference, Houston, TX, USA, 30 Apr-4 May 1979)
1	4:43865	*See* SAND-78-1841C
CONF-790445-		(19. annual meeting of the institute of environmental sciences, Seattle, WA, USA, 29 Apr-2 May 1979)
2	4:43717	Dep. NTIS, MF A01
3	4:42794	Dep. NTIS, PC A02/MF A01
4	4:42962	Dep. NTIS, MF A01
CONF-790446-		(4. annual heat pump technology conference, Stillwater, OK, USA, 9-10 Apr 1979)
1	4:42808	Dep. NTIS, PC A02/MF A01
CONF-790447-		(Health implications of the new energy technologies, Park City, UT, USA, 4-7 Apr 1979)
1	4:42560	*See* BNL-25935
CONF-790448-		(SPIE, Washington, DC, USA, 17-18 Apr 1979)
3	4:44188	*See* UCRL-82513
CONF-790449-		(EPA fuel conversion symposium, Hollywood, FL, USA, 17-20 Apr 1979)
2	4:42191	Chicago, IL; Institute of Gas Technology (1979).
CONF-790451-		(3. European congress on operations research, Amsterdam, Netherlands, 9-11 Apr 1979)
1	4:42561	Dep. NTIS, PC A02/MF A01
CONF-790453-		(Society Mfg Engrs international exposition, Detroit, MI, USA, 30 Apr-3 May 1979)
1	4:43584	*See* RFP-2916
CONF-790454-		(DECUS spring mini/midi symposium, New Orleans, LA, USA, 17-20 Apr 1979)
1	4:44183	*See* SLAC-PUB-2302
2	4:43596	*See* UCRL-82046
CONF-790455-		(Joint national meeting of the Institute of Management Sciences and the Operations Research Society of America, New Orleans, LA, USA, 30 Apr-2 May 1979)
1	4:42406	*See* LA-UR-78-2412
2	4:43206	Dep. NTIS, PC A02/MF A01
CONF-790456-		(Symposium on cell compartmentation and metabolic channeling, Thuringia, F.R. Germany, 7-13 Apr 1979)
1	4:43796	Dep. NTIS, PC A02/MF A01
CONF-790457-		(1979 photovaltaic solar energy conference, West Berlin, F.R. Germany, 23-26 Apr 1979)
1	4:42562	Dep. NTIS, PC A02/MF A01
CONF-790458-		(Symposium on environmental and climatic impact of coal utilization, Williamsburg, VA, USA, 17-19 Apr 1979)
1	4:43742	*See* UCRL-82540
2	4:42230	Dep. NTIS, PC A02/MF A01
CONF-790459-		(Instrument Society of America, Pittsburgh modeling and simulation conference, Pittsburgh, PA, USA, 25-27 Apr 1979)
1	4:42845	*See* LA-UR-79-1012
2	4:42653	Dep. NTIS, PC A02/MF A01
4	4:43175	Dep. NTIS, PC A02/MF A01
6	4:43780	Dep. NTIS, PC A02/MF A01
CONF-790460-		(Society of Petroleum Engineers California regional meeting, Ventura, CA, USA, 18-20 Apr 1979)
1	4:42283	*See* LBL-8816
CONF-790461-		(Spring meeting of the association of SYSTEM 2000 Users for technical exchange (ASTUTE), Austin, TX, USA, 3-5 Apr 1979)
1	4:44192	*See* BNL-26010
2	4:44193	Dep. NTIS, PC A03/MF A01
CONF-790463-		(IAEA technical committee and workshop on the plasma physics of intense neutral beam heating in Tokamaks, Oak Ridge, TN, USA, 25 Apr-1 May 1979)
1	4:44107	Dep. NTIS, PC A02/MF A01
CONF-790466-		(Idaho section of American Society of Mechanical Engineers--fusion energy symposium, Idaho Falls, ID, USA, 19 Apr 1979)
1	4:44141	*See* SAND-79-0600C
CONF-790471-		(20. association for ERDA systems, operations and programming meeting, Gatlinburg, TN, USA, 25 Apr 1979)
1	4:44172	Dep. NTIS, PC A02/MF A01
CONF-790474-		(Symposium on known effects of low level radiation exposures, Pittsburgh, PA, USA, 25 Apr 1979)
1	4:43826	*See* LBL-9084
CONF-790487-		(NATO advanced study Institute on ordering in strongly - fluctuating condensed - matter systems, Geilo, Norway, 16-27 Apr 1979)
2	4:43938	*See* BNL-26168
CONF-790503-		(Spring meeting of society for experimental stress analysis, San Francisco, CA, USA, 20-25 May 1979)
3	4:43404	*See* UCRL-82308
CONF-790505-		(25. ISA international instrumentation symposium, Anaheim, CA, USA, 7-9 May 1979)
7	4:43698	Dep. NTIS, PC A02/MF A01
9	4:42994	Dep. NTIS, PC A02/MF A0
CONF-790507-		(IAEA symposium on physics and chemistry of fission, Julich, F.R. Germany, 14-18 May 1979)
4	4:44033	*See* LA-UR-79-1082
5	4:44026	*See* LA-UR-79-1306
6	4:44036	*See* UCRL-81888

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CONF-790518-	(10. US/UK symposium on neutron generators, Albuquerque, NM, USA, 21-25 May 1979)	
6	4:43403	*See* SAND-79-0193C
CONF-790521-	(American Society for Microbiology, Los Angeles, CA, USA, 7-11 May 1979)	
1	4:43816	*See* DP-MS-78-93
CONF-790522-	(EMC symposium and exhibition, Rotterdam, Netherlands, 1-3 May 1979)	
1	4:44065	*See* UCRL-82105
CONF-790524-	(6. international congress symposium on radiation research and stem cells, Tokyo, Japan, 13-19 May 1979)	
3	4:43921	Dep. NTIS, PC A02/MF A01
4	4:43671	*See* LA-UR-79-1236
5	4:43831	*See* BNL-26107
CONF-790525-	(8. IMEKO congress, Moscow, USSR, 21 May 1979)	
1	4:44173	Dep. NTIS, PC A02/MF A01
CONF-790527-	(Workshop on public policy aspects of high capacity electric power transmission, Aspen, CO, USA, 14-16 May 1979)	
1	4:42874	*See* LA-UR-79-1057
CONF-790528-	(International discussion meeting about what do we know about radial shape of nuclei in the Ca region, Karlsruhe, F.R. Germany, 2-4 May 1979)	
1	4:44005	*See* LA-UR-79-1043
CONF-790529-	(Conference on Optics, Los Alamos, NM, USA, 23-25 May 1979)	
2	4:44139	*See* LA-UR-79-1420
CONF-790530-	(Energy conservation symposium, San Francisco, CA, USA, 1 May 1979)	
1	4:42774	Dep. NTIS, MF A01
CONF-790532-	(Fast reactor fuel reprocessing symposium, Dounreay, UK, 15-18 May 1979)	
1	4:42380	Dep. NTIS, PC A04/MF A01
2	4:42381	Dep. NTIS, PC A04/MF A01
CONF-790533-	(2. IAEA Advisory Group meeting on transactinium isotope nuclear data, Cadarache, France, 2-5 May 1979)	
1	4:44028	Dep. NTIS, PC A03/MF A01
CONF-790534-	(3. annual TNO users meeting, Arlington, TX, USA, 2-3 May 1979)	
1	4:43591	*See* Y/DA-8297
CONF-790535-	(5. GCFR heat transfer specialists meeting, Wurenlingen, Switzerland, 14 May 1979)	
3	4:42910	Dep. NTIS, PC A02/MF A01
CONF-790536-	(2. Echelon armor interdiction symposium, Chicago, IL, USA, 1-3 May 1979)	
1	4:43703	*See* SAND-79-0412C
CONF-790538-	(Fast ion transport in solids-electrode and electrolytes conference, Lake Geneva, WI, USA, 21-25 May 1979)	
2	4:43481	*See* COO-1198-1258
3	4:43449	*See* SAND-79-0541C
4	4:43476	*See* BNL-26099
5	4:44047	*See* SAND-79-0544C
CONF-790540-	(2. international conference on megagauss magnetic field generation and related topics, Washington, DC, USA, 29 May-1 Jun 1979)	
1	4:44126	*See* SAND-79-1085C
4	4:44048	*See* UCRL-81797
6	4:43897	*See* UCRL-82194
7	4:43589	*See* UCRL-82677
8	4:44079	*See* LA-UR-79-1409
CONF-790541-	(International Solar Energy Society meeting, Atlanta, GA, USA, 28 May 1979)	
1	4:42542	*See* SAND-79-1120C
2	4:42581	*See* SAND-79-0504C
4	4:42552	*See* LA-UR-79-1369
5	4:42678	*See* LA-UR-79-1337
6	4:42538	*See* LA-UR-79-1335
8	4:42740	*See* IS-M-207
9	4:42650	*See* SAND-78-1894C
13	4:42743	*See* SAND-79-1116C
CONF-790542-	(33. annual technical conference of the American Society of Quality Control, Houston, TX, USA, 14-16 May 1979)	
1	4:43492	*See* AGNS-1040-65
CONF-790544-	(12. symposium on the interface, Waterloo, Canada, 10-11 May 1979)	
1	4:44178	*See* LA-UR-79-1086
CONF-790545-	(Time-dependent Hartree-Fock international workshop, Gif-sur-Yvette, France, 28 May-1 Jun 1979)	
1	4:43979	*See* LA-UR-79-1102
CONF-790549-	(Conference on computerized data - acquisition systems in particle and nuclear physics, Santa Fe, NM, USA, 14-17 May 1979)	
5	4:44179	*See* LA-UR-79-1172
CONF-790602-	(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)	
13	4:42995	Dep. NTIS, PC A02/MF A01
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43	4:42965	*See* BNL-25641
58	4:42391	Dep. NTIS, PC A02/MF A01
CONF-790605-	(20. annual logging symposium, Tulsa, OK, USA, 3-6 Jun 1979)	
4	4:43863	*See* LA-UR-79-1054
5	4:43862	*See* LA-UR-79-1053
CONF-790610-	(International conference on nuclear physics with electromagnetic interactions, Mainz, F.R. Germany, 5-9 Jun 1979)	
1	4:43987	*See* UCRL-82570
CONF-790611-	(AIAA terrestrial energy systems conference, Orlando, FL, USA, 4-6 Jun 1979)	
3	4:42575	*See* LA-UR-79-950
CONF-790614-	(National computer conference 1979, New York, NY, USA, 4-7 Jun 1979)	
1	4:44185	*See* UCRL-81922
CONF-790615-	(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)	
3	4:42934	American Society of Mechanical Engineers, 345 East 47th Street, New York, NY
5	4:42903	*See* GA-A-15188
6	4:42917	*See* GEFR-SP-149
8	4:43001	*See* DP-MS-78-73
11	4:42911	Dep. NTIS, PC A04/MF A01
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1	4:43618	*See* KAPL-4116
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2	4:44131	*See* LA-UR-79-1436
CONF-790624-	(21. annual ASME conference symposium on turbulent boundary layers, Niagara Falls, NY, USA, 18-20 Jun 1979)	
1	4:43937	*See* LA-UR-79-4
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3	4:42901	*See* BNL-NUREG-25715
4	4:42902	*See* BNL-NUREG-25717
5	4:43469	*See* BNL-NUREG-25735
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1	4:43630	*See* SAND-79-0049C
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3	4:43853	*See* UR-3490-1561
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1	4:44187	*See* UCRL-81974
2	4:44176	*See* LA-UR-79-251
CONF-790630-	(5. underground coal conversion symposium, Alexandria, VA, USA, 18-21 Jun 1979)	
3	4:42237	*See* UCRL-81970
4	4:42189	*See* UCRL-82428
5	4:42260	*See* LA-UR-79-1189
6	4:42187	*See* SAND-79-1021C
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2	4:42949	*See* SAND-79-0978C
3	4:43463	*See* SAND-79-0894C
4	4:43464	*See* SAND-79-0924C
5	4:43465	*See* SAND-79-0925C
CONF-790633-	(American industrial hygiene conference, Chicago, IL, USA, 1 Jun 1979)	
1	4:43852	*See* UCRL-81757

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1	4:43757	*See* DP-MS-78-87
CONF-790636-		(Workshop on process and systems dynamics and control, ASME, Denver, CO, USA, 20 Jun 1979)
1	4:43174	*See* BNL-26045
CONF-790639-		(43. Westinghouse annual machine tool forum, Pittsburgh, PA, USA, 4-6 Jun 1979)
1	4:43590	*See* Y/DA-8211
CONF-790641-		(Rare earth research conference, Fargo, ND, USA, 25-28 Jun 1979)
1	4:43521	*See* RFP-2878
3	4:43515	*See* IS-M-209
4	4:43412	*See* IS-M-210
5	4:43383	*See* IS-M-203
CONF-790645-		(IEEE international conference on plasma science, Montreal, Canada, 4-6 Jun 1979)
2	4:44076	Dep. NTIS, PC A02/MF A01
CONF-790659-		(International district heating association 1979 annual conference, Dixville Notch, NH, USA, 19-20 Jun 1979)
2	4:43344	Dep. NTIS, PC A03/MF A01
CONF-790706-		(1979 IEEE Annual conference on nuclear and space radiation effects, Santa Cruz, CA, USA, 17-20 Jul 1979)
4	4:43673	*See* SAND-79-0615C
CONF-790802-		(International conference on structural mechanics in reactor technology, Berlin, F.R. Germany, 13-17 Aug 1979)
14	4:44138	*See* LA-UR-79-432
15	4:44186	*See* UCRL-81931
CONF-790803-		(14. intersociety energy conversion conference, Boston, MA, USA, 5-10 Aug 1979)
2	4:42741	*See* MLM-2616(OP)
3	4:42745	*See* SERI/TP-35-208
17	4:43368	*See* UCRL-82710
18	4:42543	*See* UCRL-82080
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22	4:43583	*See* LA-UR-79-1241
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26	4:42480	*See* BNL-26130
CONF-790808-		(18. ASME national heat transfer conference, San Diego, CA, USA, Aug 1979)
3	4:43166	*See* SAND-78-2282C
CONF-790813-		(14. annual meeting of the Microbeam Analysis Society, San Antonio, TX, USA, 13-17 Aug 1979)
3	4:42350	*See* DP-MS-79-1
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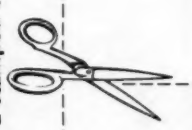

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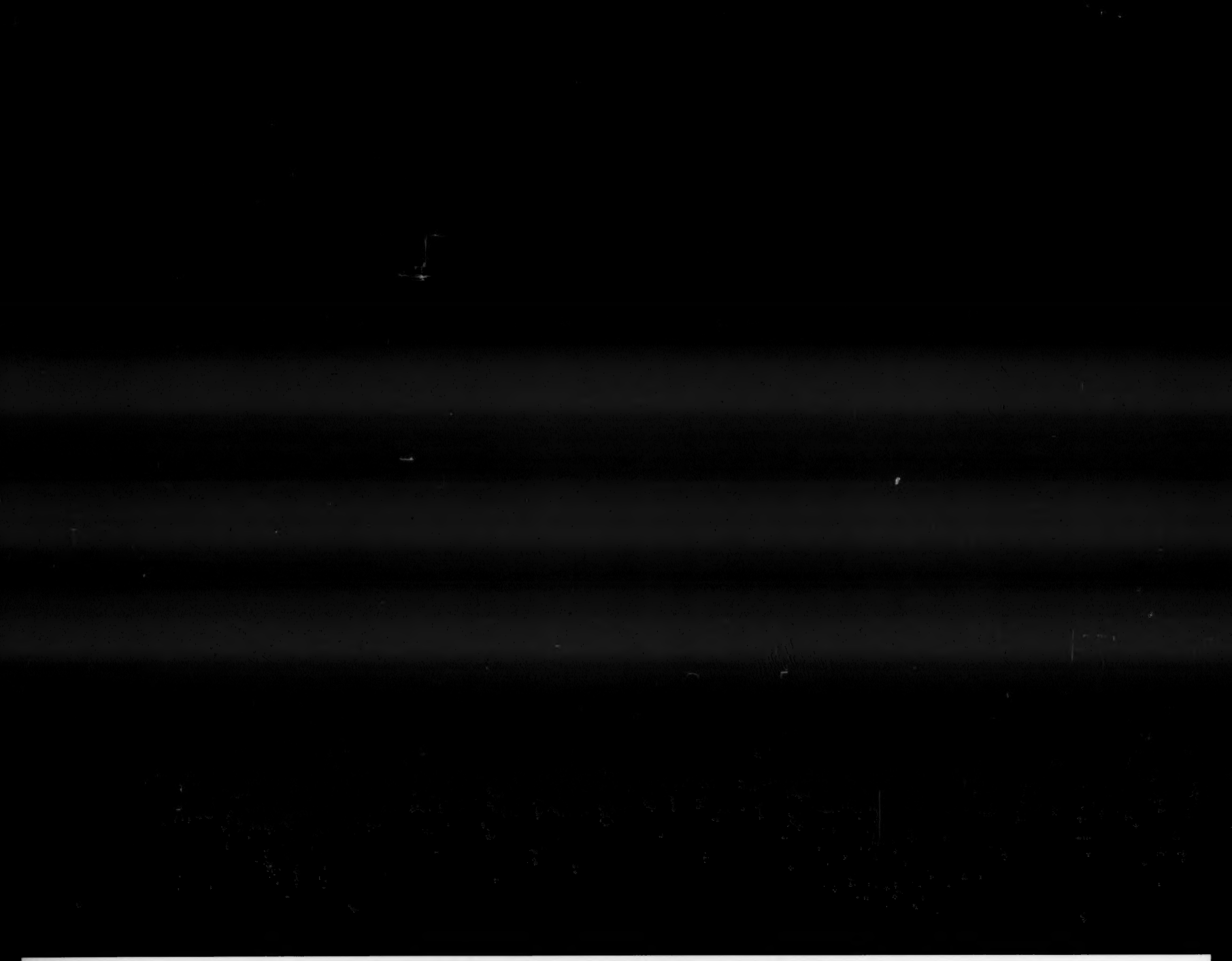
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